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PROJECT MANAGEMENT AS RELATED TO WEAPON DEVELOPMENT IN NAVY RESEARCH AND DEVELOPMENT ORGANIZATIONS

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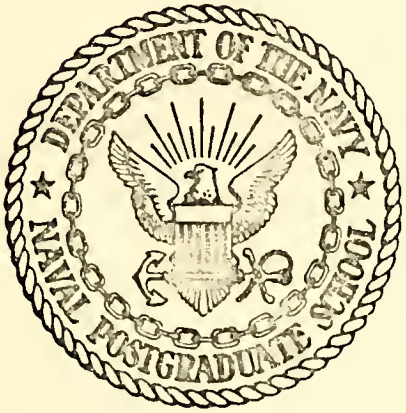

THESIS

PROJECT MANAGEMENT AS RELATED
TO WEAPON DEVELOPMENT
IN NAVY RESEARCH
AND DEVELOPMENT ORGANIZATIONS

by

William Scott Munro

and

Anthony Charles Brennan

Thesis Advisor: Peter Demayo

June 1973

T15514

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Project Management as Related to Weapon Development

in

Navy Research and Development Organizations

by

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MASTER OF SCIENCE IN MANAGEMENT

from the

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June 1973

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ABSTRACT

The study investigates the role of Navy laboratories in the systems acquisition process. In particular, it looks at an attempt to expand the laboratories' traditional role of technical management to include complete management of hardware projects in advanced and engineering development phases. The AGILE air-to-air missile development, the basis for this study, presents an opportunity to test the feasibility of decentralized management of defense procurement in actual practice.

In evaluating the effectiveness of Navy management of the acquisition process it is recognized that more than one criteria may be relevant. The evaluation is based on two standards of measurement: compliance with Department of Defense policy and conformance to generally accepted principles of management.

AGILE, a current development program, is traced from inception to the present and unique management problems are discussed. The authors conclude that unless a total commitment to decentralized management is made the present management structure should be retained.

TABLE OF CONTENTS

I. INTRODUCTION.....6

A. THE PROBLEM.....6

B. A SEARCH FOR AN ANSWER.....7

C. THE HYPOTHESIS.....8

D. THE INVESTIGATION.....8

E. CRITERIA FOR EVALUATION.....9

1. Management Principles.....11

2. Department of Defense Policy.....14

F. FORMAT.....16

II. THE NAVY LABORATORIES.....18

A. INTRODUCTION.....18

B. HISTORY.....18

1. Founding of Government Laboratories.....18

2. The Navy Laboratories.....19

3. The Need for a Change.....20

4. Consolidation of the Navy Laboratories.....21

C. PURPOSE OF NAVY IN-HOUSE LABORATORIES.....21

D. ORGANIZATION OF NAVY RESEARCH CENTERS AND LABORATORIES.....22

1. General.....22

2. Internal Laboratory Organization.....23

3. The Chief of Navy Laboratories.....27

E. MISSIONS AND FUNCTIONS OF THE NAVY LABORATORIES...28

1. Missions.....28

2. Functions of the Naval Laboratories.....29

F. ROLE OF THE NAVY LABORATORIES.....29

III. THE LABORATORY-SYSTEMS COMMAND INTERFACE.....31

A. PURPOSE.....31

B. THE NAVAL SYSTEMS COMMAND-LABORATORY PARTNERSHIP..31

1. Background.....31

2. The Navy Industrial Fund.....32

3. Organizational View of the Systems Command-Field Activity Interface.....34

C. THE AIRTASK.....37

D. THE LEADING FIELD ACTIVITY.....38

E. PROJECT MANAGEMENT CONTROL.....38

F. AN EXPANDED ROLE FOR THE LABORATORIES.....39

IV. THE AGILE DEVELOPMENT.....43

A. BACKGROUND.....43

B. THE NAVAL WEAPONS CENTER-NAVAL AIR SYSTEMS COMMAND AGREEMENT.....46

1. Background.....46

2. Specific Organizational Relationship.....48

3. Naval Air Systems Command Functions.....52

4. Management Functions Assigned to the Naval Weapons Center.....55

C. CURRENT STATUS.....55

1. Progress in Technical Areas.....55

2. Management Emphasis.....56

3. Industry Participation.....57

4. The Naval Air Systems Command Role.....58

5. The NWC AGILE Project Organization.....59

V. AGILE EVALUATED.....63

A. INTRODUCTION.....63

B. PLANNING FOR CHANGE.....64

C. PLANNING FOR DECENTRALIZATION.....67

D. ORGANIZATION AND STAFFING.....68

E. CONTROL.....73

F. COMMUNICATING AND DIRECTING.....76

VI. CONCLUSIONS.....78

Appendix A. Interviews Conducted.....83

Appendix B. COMNAVAIR-COMNAVWPNSCEN Agreement Concerning the Advanced Development and Prototype Test and Evaluation Programs for AGILE Guided Missile Weapon System.....85

Appendix C. Naval Weapons Center, China Lake Mission Statement.....92

Appendix D. Assistant Secretary of the Navy (Research and Development) Memorandum dated 26 April 71.94

Appendix E. Chief of Naval Operations Memorandum 2139 dated 6 February 71.....95

BIBLIOGRAPHY.....96

INITIAL DISTRIBUTION LIST.....103

FORM DD 1473.....104

I. INTRODUCTION

A. THE PROBLEM

One of the most serious problems confronting the Department of Defense is inefficiency in the management of the acquisition of major new weapons systems. The record of the past decade indicates generally poor performance in terms of the cost effectiveness of the systems procured. It is difficult to find a development program without major cost growth, schedule slippage, or other difficulties. Many systems being developed failed to achieve performance goals, especially in the areas of reliability and maintainability. These real shortcomings, magnified by the general anti-defense attitude present in the nation as a result, in part, of our Vietnam involvement, has generated widespread concern for the quality of systems acquisition management.

The news media provides daily evidence of the concern voiced in the committee rooms and on the floor of Congress that cost overruns and deficient performance have been the consistent result of weapons systems acquisition programs. Since 1969, industry councils, defense review boards, and a Presidential Blue Ribbon Commission have all recommended changes in the policies and procedures governing defense system acquisition activity. The General Accounting Office has reported extensively on the problem and even congressmen generally considered friendly to the military establishment have become increasingly identified with a critical view of the existing state of affairs.

B. A SEARCH FOR AN ANSWER

In seeking ways to improve the procurement of new weapon systems in the Navy a number of innovative ideas have been proposed. This study is concerned with one such idea presently being tested: placing the responsibility for management of a major system development program in a Navy laboratory. It examines the creation of a project office for the development of the AGILE Advanced Short Range Air-to-Air Missile System and the assignment of total program management as the "direct responsibility of the Naval Weapon Center, China Lake, California."[1]

Navy laboratories have long been deeply involved with the definition of mission requirements and the military applications of technological advance. They represent a wealth of knowledge that can be helpful in a variety of ways in the task of providing effective and credible weapons systems to the fleet. Within its field of specialization, each Navy laboratory and research center is responsible for a number of missions and functions such as warfare analysis, advancement and application of technologies of unique military interest, development of new weapon systems concepts and acting as technical advisors to both operating and material commands.

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[1]Assistant Secretary of the Navy (Research and Development) memorandum to the Chief of Naval Operations and the Chief of Naval Material, Subject: AGILE Weapon System Development; responsibility assignment, 26 April 1971.

C. THE HYPOTHESIS

The concept of project management employing a matrix organization is not new. It has long been used by the Navy systems commands and the private defense industry for the management of acquisition and development programs. The concept is equally at home in the Navy laboratories where it gained early acceptance. What is unique is the concept of placing total system management responsibility in the laboratory environment.

On the surface, the AGILE program would seem to involve more of a change in management emphasis than a fundamental change in the way the Navy manages the acquisition process. It is a logical development in the current trend toward decentralization and participatory management in the Department of Defense. It is, however, the hypothesis of this paper that implementing the decision to manage a large and important acquisition in the laboratory requires fundamental changes to organization and staffing and a definition of the relationships between the laboratory and other organizations involved in the Navy acquisition process. If project management is to function successfully in the laboratory, the laboratory's goals and objectives must be modified as well.

D. THE INVESTIGATION

The purpose of this investigation is to examine the AGILE missile development at the Naval Weapon Center, China Lake to determine the effectiveness of decentralization in systems acquisition management. It was conducted in three

parts. Part one consisted of research in basic management disciplines to arrive at a useful definition of Project Management. During this phase, documentation for the AGILE program was gathered and analyzed. Part two consisted of observation and data collection conducted at the Naval Weapon Center, China Lake. This effort consisted of four visits spaced over a period of seven months. The organization and staffing of the AGILE project team was reviewed and in-depth interviews were conducted. Visits were timed to coincide with key decision points in the development cycle to permit first-hand observation of the decision process whenever possible. The data generated by these interviews became the basis for the third part of the investigation. Part three consisted of the gathering of information concerning the attitudes of top Navy and Department of Defense management toward project management. Interviews were conducted for two purposes: Officers and civilian managers with a direct interest in the AGILE missile development program were questioned about issues, facts, expectations and opinions held concerning that program. They, along with the managers and personnel of other programs were interviewed to obtain information related to the current DoD project management environment.

E. CRITERIA FOR EVALUATION

Perhaps the most difficult task encountered was that of defining the standards by which systems acquisition management will be judged. One problem lies in the fact that more

than one objective is associated with the AGILE program. The primary goal is development of an effective air-to-air missile. Subsidiary goals include learning more about the costs associated with development programs and stimulating the growth of effective management in the laboratories. Each goal implies a different criteria for evaluation. Another problem is associated with the scope of the investigation. Specific management actions that appear to be warranted from a program standpoint may not be optimal from a Department of Defense or government-wide point of view. The third difficulty is related to the stage of development in which the investigation ended. The AGILE program is currently in the later stages of advanced development. Selection of a systems integrating contractor to work in partnership with the Naval Weapons Center in engineering development is pending. This investigation was conducted during a seven month period from August 1972 to February 1973 during this most interesting period in AGILE's life cycle.

The use of an on-going program as the focus for this study lends relevance, and, for the authors, greater interest to the effort. It does, however, impose certain limitations on the scope of the study. The most important measure of the success of the systems acquisition process is the quality of the end product. An effective, reliable weapon system delivered to the fleet on time and at a reasonable cost is the ultimate criteria against which AGILE management

should be judged. This final judgement is still several years in the future. Conclusions reached at this time concerning the effectiveness of AGILE management are, of necessity, speculative.

The criteria by which the overall AGILE program management will be measured are taken from the widely accepted principles of management set forth by both scholars and practitioners. They will be applied from a program oriented point of view. In addition, program management will be measured for compliance to established Department of Defense policy.

1. Management Principles

a. Planning

Planning is the process by which the manager develops the roadmap to enterprise objectives. Specific policies, objectives and guidelines have to be developed for each enterprise, and these must be clearly understood and supported at all levels in the organization. The greater the degree of vertical goal congruence within the organization, the better the chance of reaching the objective.

Planning implies change, and people, both managers and employees, who have developed patterns of thought and behavior related to specific objectives find it hard to change. Closely allied to this psychological inflexibility are the inflexibilities inherent in policies, procedures and traditions. Once established, these become ingrained in the

organization and changing them is difficult. Being aware of these obstacles, top management, with the participation of subordinate managers, must develop a plan which provides for the organizational changes necessary for decentralization. When an organization faces the need for decentralization, research and planning are required. Not only must the requirement of finding the right people to fill key positions be met but the following four essential features of decentralized authority and responsibility must be provided for:

1) Management must functionalize planning and control, consolidating these tasks in a separate department.

2) Management must make a precise determination of the lines of authority and responsibility.

3) Management must define clearly the methods by which the various division and department heads can participate in planning.

4) Management must develop methods of control which are adapted to the need of coordinated action in a decentralized organization.

Decision making is vital to planning. In the system acquisition process the selection of an alternative solution is made as the result of a trade-off analysis. The decision should be based on a selection from all available alternatives and be a matter of weighing expected results against total program objectives.

b. Execution

In order to accomplish organizational objectives, carry out plans, and encourage subordinates to work effectively and efficiently a controlled and effectively-directed organization must be put into being in the execution phase of the management process.

1) Organization and Staffing

Two functions of management, organization and staffing, are so closely related that they are often discussed together without any distiction. An organization structure should be designed to clarify the environment so that everyone knows who is to do what, to remove obstacles to performance caused by confusion and uncertainty of assignment, and to furnish a communications network reflecting and supporting enterprise objectives.

2) Control

Another basic function of management is control. Control is the process that measures current performances and guides it toward some predetermined goal. The essence of control lies in checking existing actions against some desired results determined in the planning process. When deviations are uncovered, corrective action is taken. The essential elements of any control system are: a predetermined goal, a means for measuring current activity (quantitatively, if possible), a means of comparing current activity with the goal, and the means of correcting current activity so as to achieve the desired result. Planning is a prerequisite for this important managerial function.

3) Communicating and Directing

The discussion of the functions of the managerial process is concluded by focusing attention on communicating and directing. Communication provides a link among all other functions while direction initiates actual performance.

The effectiveness of a communication is a serious problem. Usually the more direct the communication, the more effective it will be. In an organization, the number of levels through which a communication travels affects the action that is finally taken. Thus, the communication problem increases as the size of the organization increases. Of course, effectiveness of communications depends upon both efficient transmission of messages and the understanding of their meaning. In the final analysis, the acceptance of the communication is the key to effectiveness.

The directing function of management is the heart of the managerial process because it is involved with initiating actions that put into effect the decisions, plans and programs for achieving the organizational goal. Although an important part of directing, individual management styles will not be discussed in this paper.

2. Department of Defense Policy

Weapon systems acquisition management must interact with the complex system employed by the Secretary of Defense to administer and control those resources entrusted to the Department of Defense. The layers of authority above the

project level impose important constraints on the Project Manager's freedom of decision. The success of the program he manages depends, in part, on how well he interacts with that environment. For a better understanding of the environment in which the Project Manager functions, the reader is directed to the source material listed in the bibliography. The authors found the following materials especially useful:

_____, Introduction to Military Program Management. (IMI Task 69-28) Washington, D.C.: Logistics Management Institute, 1969.

Department of the Navy, Assistant Secretary of the Navy (Research and Development) Department of the Navy RDT&E Management Guide, Part I: System Description, NAVSOP 2457 (Rev. 7-72).

_____, Navy Research, Development, Test and Evaluation Program. Washington, D.C.: Naval Material Command, March 1972.

_____, Research and Development in Department of Defense. Washington, D.C.: Office Director of Defense Research and Engineering, November, 1971.

Department of Defense Directive 5000.1, Subject: Acquisition of Major Defense Systems, 13 July 1971.

Department of the Navy Programming Manual.

Current Department of Defense Systems acquisition policy was first set forth by former Deputy Secretary of Defense David R. Packard in a memorandum dated 28 May 1970.[2] That guidance was promulgated as official policy by Department of Defense Instruction 5000.1. The instruction

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[2]Department of Defense, Deputy Secretary of Defense David R. Packard Memorandum, Policy Guidance on Major Weapon System Acquisition, 28 May 1970.

recognizes the need for sound management in the Department of Defense and attempts to apply generally accepted management principles to the systems acquisition process. Pertinent provisions of this instruction related to program management include the following:

a. "Responsibility and authority for the acquisition of major defense systems shall be decentralized to the maximum practicable extent consistent with the urgency and importance of each program."

b. "The development and production of a major defense system shall be managed by a single individual (program manager) who shall have a charter which provides sufficient authority to accomplish recognized program objectives."

c. "Layers of authority between the program manager and his Component Head shall be minimum."

d. "The assignment and tenure of program managers shall be a matter of concern to DoD Component Heads and shall reflect career incentives designed to attract, retain and reward competent personnel."[3]

In the opinion of the authors, these principles and the policies they support are sound. They are another standard against which AGILE management will be measured.

F. FORMAT

The remainder of this paper is organized into five chapters. Chapter II discusses the evolution of the modern Navy

[3]Department of Defense Directive 5000.1, Acquisition of Major Defense Systems, 13 July 1971.

laboratory system and the laboratory's traditional missions, functions and role in the systems acquisition process. Organizational relationships and management of the laboratory system are presented. Chapter III examines the working relationship between the laboratories and their customers in the Naval Systems Commands. Problem areas identified by various government commissions and study groups are reviewed. Chapter IV presents the AGILE Missile Development Program from its inception to the present. The decision to place management responsibility in the field and the Naval Weapons Center-Naval Air Systems Command working agreement specifying the organizational relationships and responsibilities for the program are covered. The organization and staffing of the AGILE project at NWC China Lake and its relationship with higher echelons within the Navy is discussed. In Chapter V AGILE management is evaluated using the criteria presented in the introductory chapter. Chapter VI presents the authors' conclusions concerning the effectiveness of AGILE management.

II. THE NAVY LABORATORIES

A. INTRODUCTION

The Navy laboratories have long been partners in the weapon systems acquisition process with the material command and with industry. As an aid in understanding the role the laboratories now play and assessing the feasibility of having the laboratories assume total responsibility for program management, the history and evolution of Navy and other government laboratories is traced. Present organizational relationships, missions, functions and roles of Navy laboratories and research centers are specified. Problem areas and management issues pertinent to the purpose of this paper are examined.

B. HISTORY

1. Founding of Government Laboratories

The Department of Defense in-house laboratories trace their history back to the establishment of the Springfield Arsenal in 1790. The traditional role of the arsenal system was the production of war materials.[4] In support of this production mission, the arsenal system maintained an in-house capability to perform research and development as well as manage and direct private contractor efforts. Emphasis was

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[4] This mission was specified by Congress in 10 US Code 4532 during World War I which stipulated that "the Secretary of War should have his supplies made in factories or arsenals owned by the United States, so far as those factories or arsenals can make those supplies on an economical basis."

placed on maintaining an independent capability to evaluate and manage development contacts in support of defense decision makers. The in-house laboratories performed this technical management function through production prototyping, at which time the production function was turned over to industry.

2. The Navy Laboratories

World War II brought about the break with the traditional arsenal system. The government's sudden demand for immense amounts of technical assistance in the crucial period of mobilization brought industry, as well as numerous universities into the role of research and development performers. Navy laboratories were established to satisfy the need for a capability to investigate the military applications of advances in technology and to bring military problems to the attention of the scientific community.[5] Laboratories were formed by the various bureaus to solve technical problems, provide technical advice and assist in the technical management of weapon system developments. Under the command of the various bureaus and offices, each laboratory's growth and development were dictated by the particular systems and

---

[5]The first Navy research program was started in 1830 at the Naval Observatory in the fields of magnetism, meteorology and astronomy. Another early endeavor was the Marine Engineering Laboratory, forerunner of the David Taylor Model Baisin and the Naval Ship Research and Development Center, Silver Springs, Md.. The first laboratory devoted exclusively to military research, the Naval Research Laboratory was proposed by the Naval Consultant Board of 1916, of which the distinguished scientist and engineer, Thomas Alva Edison was chairman.

equipment its sponsor had responsibility for. These independent courses of development were influenced by the changing requirements of the sponsoring bureau and changes in Navy organization and management philosophy.

3. The Need for Change

The continued reliance on contract research and development beginning in the late 1950s and extending into the 1960s led ultimately to questioning of the worth and effectiveness of in-house laboratories on many fronts.[6] During this period Secretary of Defense McNamara instituted several changes in laboratory management. Laboratories were given greater local authority over decisions on technical matters and were encouraged to expand development capabilities to encompass systems engineering development. The position of Director of Laboratories was created within each military service to provide laboratory representation at a high policy-making level.

In 1966 Dr. John S. Foster, Jr. was appointed Director, Defense Research and Engineering, bringing a new concept of the roles and missions of the laboratories to the Department

---

[6]This concern was expressed in Strengthening American Science, President's Science Advisory Committee, 1958. The Report to the President on Government Contracting for Research and Development, prepared by the Bureau of the Budget and referred to the Committee on Government Operations, United States Senate, 19 May 1962 (The Bell Report) recommended a clearer definition of the roles of in-house laboratories.

of Defense. The concept of the weapon center or "center of excellence," although not originated by Dr. Foster, won acceptance under his leadership.[7]

4. Consolidation of the Navy Laboratories

In 1966, the Chief of Naval Material assumed command of all Navy laboratories. In the next four years the fifteen laboratories that then existed were consolidated into seven research centers and three supporting laboratories that exist today. The purpose of the consolidation was to bring together in a single command the various capabilities necessary to attack complex military problems in specific warfare areas.

C. PURPOSE OF NAVY IN-HOUSE LABORATORIES

The stated policy of the Navy is to maintain in-house research and development laboratories in order to develop and prosecute scientific and technical laboratory programs having as their prime objective the improvement of Naval and Marine Corps capabilities, equipments, and systems, and to maintain a sufficient base of scientific and engineering talent, experienced in Naval and Marine Corps matters as to preclude the possibility of "technological surprise" due to

---

[7] The idea that laboratories should be organized to support military missions rather than structured along functional lines was developed as part of Task 97. When Robert S. McNamara became Secretary of Defense in 1961, he asked 120 questions to provide the basis for the future posture of the Department of Defense. Question 97 was, "Advise me ways in which to improve the operations of the in-house laboratories." To answer this question and to develop solutions to the problems identified Task 97 was established.

unforeseen applications of science and technology by potential enemies.[8] The laboratories enable the Navy to enter the marketplace in the acquisition of new weapons and weapons systems as sophisticated buyers, with technical experience and expertise in the disciplines relevant to the development of such systems. The laboratory system maintains a technical memory of past technical problems and their solutions to assist in the support of deployed equipment and its improvement while in service, and keeps continuously available the capability to exploit new technical opportunities on a quick reaction basis, often under tight security controls, for the solution of Naval and Marine Corps problems.

D. ORGANIZATION OF NAVY RESEARCH CENTERS AND LABORATORIES

1. General

That portion of the Navy organization concerned with laboratories and research centers is shown in Figure II-1. The Assistant Secretary of the Navy for Research and Development is limited to a small number of personal technical assistants. To provide the staff to fulfill his assignments, principal Navy Research, Development, Test and Evaluation (RDT&E) officials are "double hatted," reporting directly to

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[8] Department of the Navy, Headquarters Naval Material Command NAVMAT Instruction 5450.27, Chief of Naval Material Commanded Laboratories and Centers, Missions and Functions of, 27 June 1972.

the Assistant Secretary in one function. For example, the Deputy Chief of Naval Material for Development is also Chief of Naval Development and the Director of Laboratory Programs has the additional duty of Director of Naval Laboratories. The laboratories or Research Centers having responsibility for weapon system development come under the command of the Chief of Naval Material. The Naval Weapon Center, China Lake and the Naval Ordnance Lab, White Oak are examples.

2. Internal Laboratory Organization

Although it would be convenient to make some generalizations concerning the internal organizational structure of Navy laboratories, the temptation will be avoided because of the wide variation in the organizational forms growing out of the different missions, capabilities, facilities and types of programs undertaken in the individual labs.

Figures II-2 and II-3 are the organizational charts for the Naval Ordnance Laboratory, White Oak and the Naval Weapons Center, China Lake, the two facilities visited in the course of this study. Each has responsibility for the management of a major acquisition program. Although both laboratories are organized along lines of functional disciplines, they have evolved different approaches to project management organization.

The form adopted by the Naval Ordnance Laboratory, White Oak is readily recognized as a matrix organization with the Project Manager reporting to the head of the laboratory.

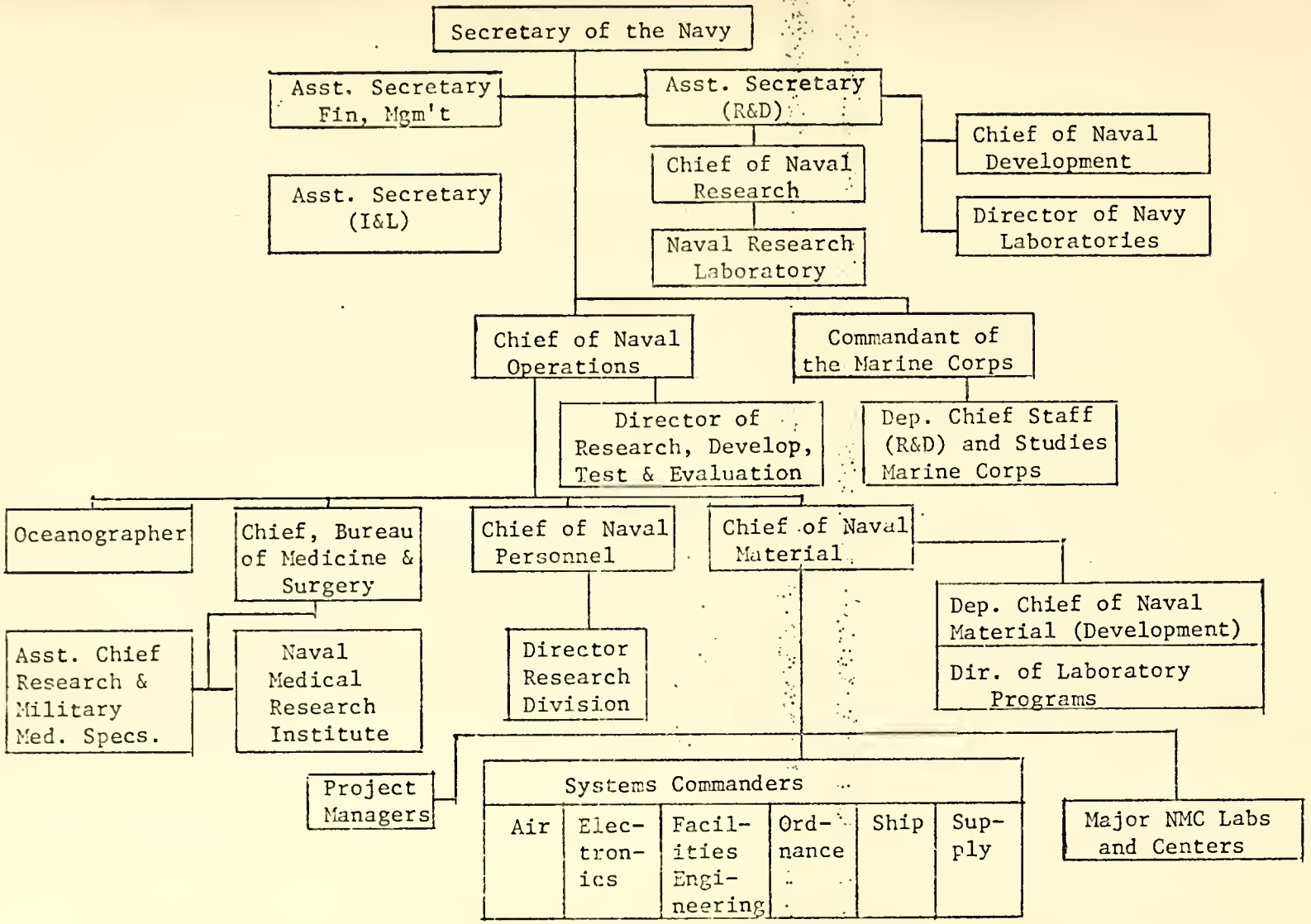

Figure II-1. NAVY WEAPON SYSTEMS ACQUISITION ORGANIZATION

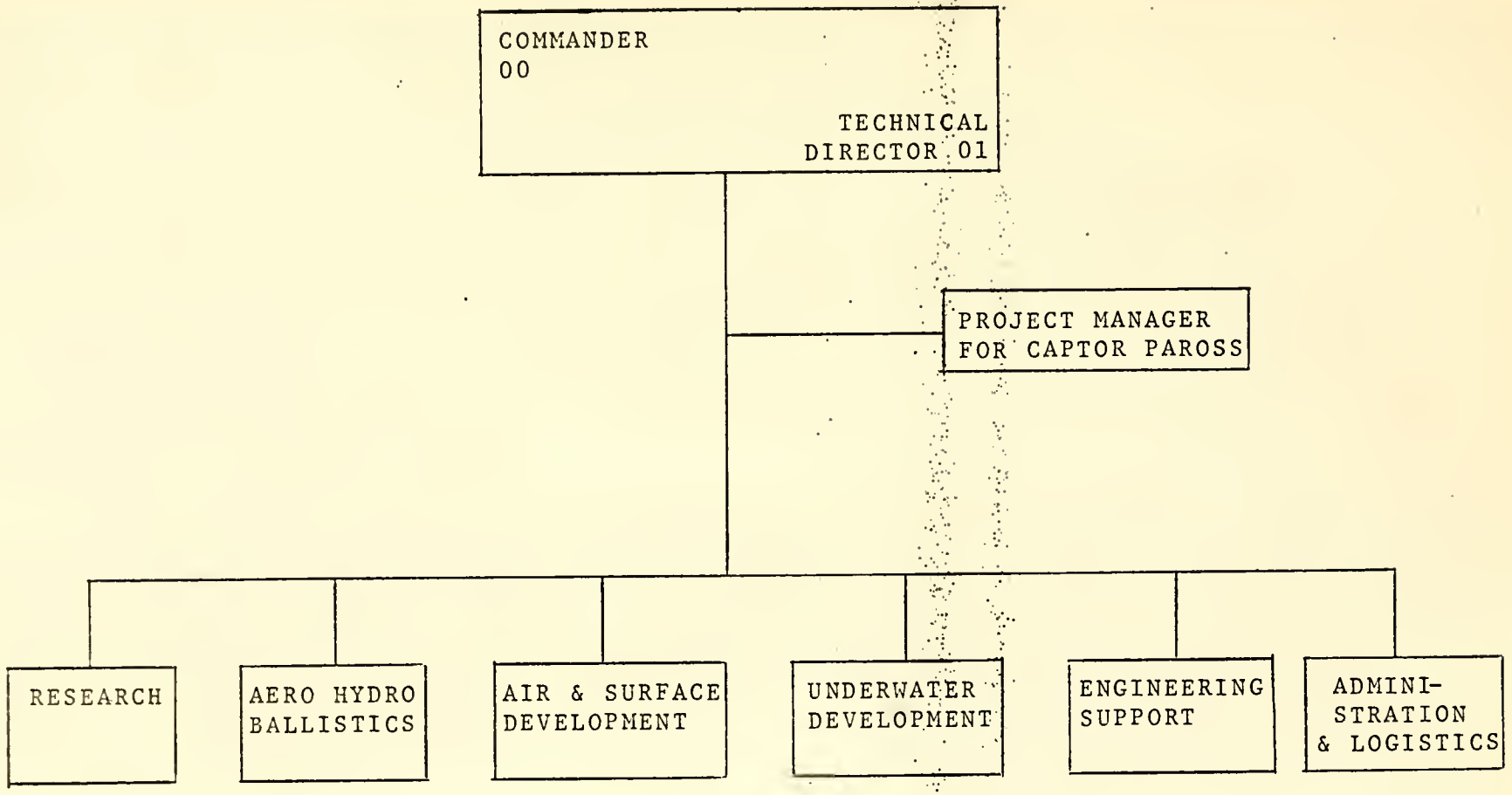

Figure II-2. NAVAL ORDNANCE LABORATORY, WHITE OAK ORGANIZATION

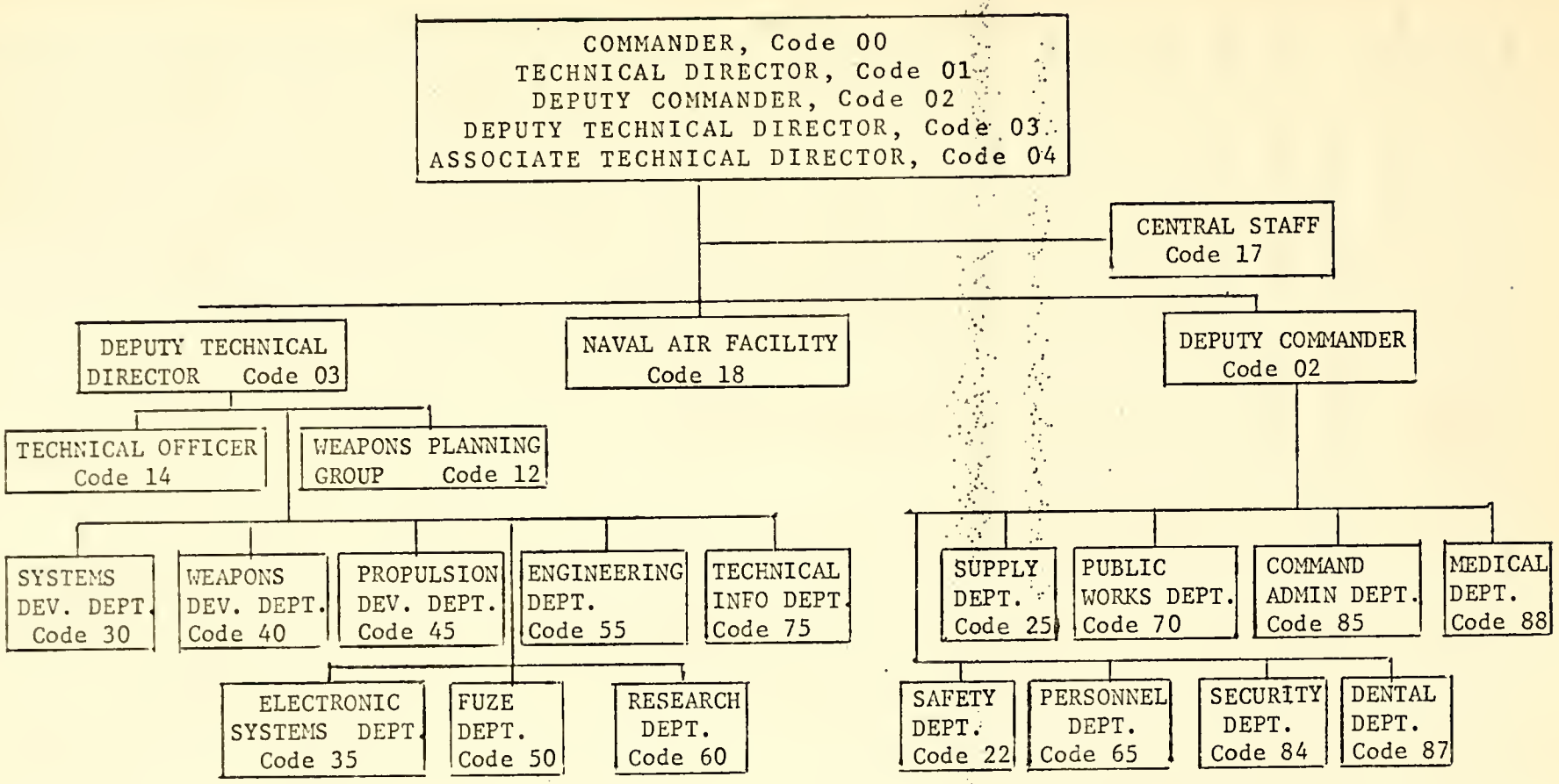
COMMANDER, Code 00
TECHNICAL DIRECTOR, Code 01
DEPUTY COMMANDER, Code 02
DEPUTY TECHNICAL DIRECTOR, Code 03
ASSOCIATE TECHNICAL DIRECTOR, Code 04
CENTRAL STAFF Code 17
DEPUTY TECHNICAL DIRECTOR Code 03
NAVAL AIR FACILITY Code 18
DEPUTY COMMANDER Code 02
TECHNICAL OFFICER Code 14
WEAPONS PLANNING GROUP Code 12
SYSTEMS DEV. DEPT. Code 30
WEAPONS DEV. DEPT. Code 40
PROPULSION DEV. DEPT. Code 45
ENGINEERING DEPT. Code 55
TECHNICAL INFO DEPT. Code 75
SUPPLY DEPT. Code 25
PUBLIC WORKS DEPT. Code 70
COMMAND ADMIN DEPT. Code 85
MEDICAL DEPT. Code 88
ELECTRONIC SYSTEMS DEPT. Code 35
FUZE DEPT. Code 50
RESEARCH DEPT. Code 60
SAFETY DEPT. Code 22
PERSONNEL DEPT. Code 65
SECURITY DEPT. Code 84
DENTAL DEPT. Code 87

Figure II-3. NAVAL WEAPONS CENTER, CHINA LAKE ORGANIZATION

The CAPTOR Project Manager has well-defined interfaces with both the Naval Ordnance Systems Command and the ASW Systems Project Manager.

The Naval Weapons Center, China Lake incorporated the AGILE project as a division of the existing Systems Development Department. The head of the AGILE Development Division is assisted by a Management Plans and Program Branch which performs accountability and record-keeping functions but has no line authority to control. The AGILE Development Division is somewhat larger than the usual Navy Project Management organization. It depends on a combination of line control of these dedicated personnel and a matrix interface with the functional organization for its support.

3. The Chief of Navy Laboratories

a. The Chief of Navy Laboratories/Director of Laboratory Programs is responsible for the management of the Naval Material Command RDT&E field activities. His duties include controlling the in-house Exploratory Development technical program and the application of programmed funds. He is responsible for assuring optimum responsiveness of the NMC RDT&E field activities to the sponsoring systems commands, offices and PMs, and for guiding the in-house laboratory Foundation Research and Independent Exploratory Development programs and controlling the application of programmed funds. He controls the management and support program and the application of programmed funds. He is responsible for establishing and sponsoring the Naval Material Command RDT&E Military

Construction Program, determining the general distribution of civilian personnal within the NMC RDT&E field complex, and directing and coordinating long-range planning of NMC RDT&E resources.

b. Under his charter as Chief of Navy Laboratories, the Chief of Navy Laboratories/Director of Laboratory Programs is responsible to the Assistant Secretary of the Navy (Research and Development) for the functions listed in the preceeding paragraph. Broader responsibilities under this charter include advising the Assistant Secretary of the Navy (Research and Development) in the selection of key personnel and establishing laboratory requirements and policies. The Director of Laboratory Programs represents the Assistant Secretary on laboratory policy matters and acts as Chairman of the Advisory Group to the Assistant Secretary of the Navy (Research and Development) on laboratory matters.

The nature of his duties suggests extensive involvement with management within the laboratories as well as his broader concern for the entire program.

E. MISSIONS AND FUNCTIONS OF THE NAVAL LABORATORIES

1. Missions

The missions of the laboratories and research centers commanded by the Chief of Naval Material are defined in terms of their orientation toward technologies, weapons platforms, or warfare areas. For example, the Naval Ordnance Laboratory is the principle Navy RDT&E center for

ordnance technology, concepts, and systems and the Naval Weapons Center is the principle Navy RDT&E center for air warfare and missile weapon systems.

2. Functions of the Naval Laboratories

Specific and detailed functions performed by the various Naval laboratories are contained in their individual Mission and Functions Statements.[9] Because this study is primarily concerned with the activities of the Naval Weapons Center, its Statement of Missions and Functions is appended as Appendix C to this study.

F. ROLES OF THE NAVAL LABORATORIES

The Navy laboratories and research centers accomplish their missions and functions by performance of a variety of tasks. Certain roles are common to all research and development centers.

The laboratories carry out programs of warfare analysis comprising intelligence studies, operations research, systems analysis, participation in fleet exercises and operations, and evaluation of fleet exercise results and operational reports to provide an understanding of the operational and support problems and opportunities facing the Fleet and Fleet Marine Forces. They constantly seek new application

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[9]These Mission and Functions Statements are consolidated as enclosures to Department of the Navy, Chief of Naval Material, NAVMAT INSTRUCTION 5450.27 CNM-Command Laboratories and Centers; Missions and Functions of. The Mission Statement for the Naval Weapons Center, China Lake is included as Appendix C.

of science and technology to Navy and Marine Corps problems and advance the state of the art in those branches of science and technology of unique or particular importance to the Navy and Marine Corps and develop new weapon systems and concepts to enhance the effectiveness of the Navy and Marine Corps, prove the feasibility of critical components, and build and demonstrate prototypes of such systems. Laboratories and research centers act as project manager or provide technical direction during the development phase of the acquisition process of new systems, when so directed, and design and conduct technical tests of equipments and systems and assist in technical and operational evaluations of new systems and procedures. The Navy laboratories act as technical advisors and consultants to CNO, CMC, CNM, the Systems Commanders, the designated Project Managers, the other Navy Bureaus and Commands, the Marine Corps Development and Education Command and the operating forces on matters within their areas of specialization. Navy research facilities maintain and provide the technical knowledge, skills, and facilities to provide assistance to development programs and to support, modify, and improve the equipments in use by the Navy and Marine Corps.

III. THE LABORATORY SYSTEMS COMMAND INTERFACE

A. PURPOSE

This chapter examines the working relationships between the Navy Systems Commands and the Navy Laboratories and compares the methods by which they accomplish weapon systems acquisition tasks. Problem areas in weapon systems acquisition management within the systems commands and the laboratories, particularly those identified by the Blue Ribbon Defense Panel, are examined.

B. THE NAVAL SYSTEMS COMMAND-LABORATORY PARTNERSHIP

1. Background

The reorganization of the Navy laboratory system in 1966 placing it under the command of the Chief of Naval Material caused a change in the relationships between the Systems Commands and the laboratories. Whereas the systems commands had been in the direct line of authority exercising chain of command control over the laboratories in which they had greatest interest, the reorganization greatly reduced the system commander's control of the laboratories. The result was a change in the system commander's role in relation to the laboratories from that of manager to the status of customer. As customer the system commanders have greatly reduced opportunity to influence laboratory policies and management practices.

The lack of line authority does not appear to have an overly important effect on the working relationship

between the systems commands and the laboratories. Prior to the reorganization, the systems commands customarily made use of that laboratory or facility best suited to solve the technical problem of the moment without regard for command relationships and the laboratories were free to accept work assignments from requesting agencies outside the sponsoring command under terms and arrangements agreeable to all parties.

The Systems Commands and the Project Managers have an obligation to manage sponsored in-house research and development no less diligently than that contracted for with private industry. In the latter case, management and control is facilitated by the contractual statement of what is to be done and how it is to be accomplished, and by the contractor's profit-oriented motivation. In dealing with Navy in-house laboratories, research and development sponsors manage and control by establishing policy and demanding excellence in the execution of assigned work tasts. Perhaps the most significant method of control is personal contact, by telephone or visit, between technical personnel at the working level. Systems commanders and Project Managers controlling the assignment of resources can use the threat of withdrawal of support or resources to stengthen their positions with respect to the laboratories.

2. The Navy Industrial Fund

The essential element of control still available to the systems commander or a designated project manager is

financial control through the funding of work packages. The system by which Navy laboratory operation is financed is the Navy Industrial Fund. Essentially, this system endows the laboratory with working capital to finance its operations. Annual appropriations are still required for a small amount of administrative support and for facilities construction, but the funds for the performance of assigned research and development including allocated overhead, are furnished by the Navy Industrial Fund. Funds expended on assigned research and development work are replenished by billing the sponsoring systems command "customer" for the full costs, including allocated overhead, of its products and services. The mechanics of funds transfer involves the issuance of a project order (NAVCOMPT Form 2053) by the sponsoring command. When the project order is accepted by the laboratory, the funds are immediately obligated by the sponsor.

In addition to the sponsored research, each laboratory conducts independent in-house research unrelated to existing systems or programs. Funding for this effort is provided by the Chief of Naval Research through the Director of Navy Laboratories and is managed by the laboratory technical director. Most of the laboratories are involved in a broad spectrum of research and development activity ranging from basic research to engineering development. The funding for this basic research falling in Navy Research and Development Budget Category 6.1, is relatively insignificant to the operation of the laboratories involved in weapon systems

development, comprising approximately five percent of the total operating budget in a typical laboratory. It is estimated that the sponsored research in Research and Development Budget categories 6.2, 6.3 and 6.4 provides 85% of the laboratory budget.[10] The systems commands and project managers determine where the work will be done.

Assignments to the laboratories are made directly in accordance with the assigned missions and functions, facilities, and technical expertise of the laboratory. Although some laboratories and systems commands are closely coupled by the nature of their missions, sponsors have no real responsibility for sustained support of the laboratories. Funding control is clearly their strongest lever in motivating laboratory management in the desired direction.

3. Organizational View of the Systems Command-Field Activity Interface

The flow of direction, policy guidance and other communications between the systems commands and the field activities may follow any of several established courses depending on the type of communication and its importance to management at the time. To understand why this is so, it is necessary to examine the working relationships employed in managing development activity.

Before doing so, several considerations and obvious distinctions that dictate or influence this organization

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[10] Department of Defense, Report of the Task Group on Defense In-House Laboratories, Annex A., 1 July 1971, p. 55.

must be mentioned. Navy laboratories have developed to varying degrees, the capability to provide management services as well as technical direction for the development programs they undertake. There is considerable variance between the various systems commands and between functional divisions within a command in technical expertise, managerial skills, and motivation to get the job done. Finally, it must be recognised that developing a missile system or an electronic component has little similarity to developing an entire airframe. A laboratory or systems command may have unique ability in one area and still be functionally inept in another. These comments are included to point out the error of generalization in discussing the systems command-laboratory interface.

Because this paper is primarily concerned with a missile development under the cognizance of the Naval Air Systems Command, that organization will be used to illustrate the organizational relationships involved in the systems command-field activity interface. Figure III-1 illustrates the organizational and command relationships and the lines of communications involved in a Naval Air Systems Command project management relationship. The project manager, chartered by the Naval Air Systems Command, reports directly to the Commander and reports to the Deputy Command for Plans and Programs for administrative purposes only. The project manager and his organization interface with the functional divisions (Research and Technology, Material Acquisition,

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Contracting and Logistics and Fleet Support) through project coordination at a working level. The head of each functional division designates a Project Support Officer as the cooridinator of project requirements within the division. There is direct communication between the project management office and the field activity but the main channel for the conduct of normal project business is through the Project Support Officers. Normally the field activity has or will evolve an organization providing counterparts for each project support officer involved in the program. They function as coordinators within the field activity and as primary point of contact for the conduct of project business. The systems commands and the laboratories/field activities are linked at the command level through the basic agreements and implementing task orders.

C. THE AIRTASK

When the system command has a need for in-house laboratory services an agreement on the scope of the work contemplated, similar to the contracts used with private industry, is worked out through negotiations between the principals involved on both sides. The negotiations are less formal and complicated than those required when contracting with industry. The cost in time and technical manhours is significantly lessened and administrative steps in providing funds and program direction are far simpler. The field activity incorporates the proposed task into its Laboratory Program Summary and this serves as a formal

proposal to the systems command sponsor. The work proposed by the field activity may be acceptable to the system command without change. In this case, the only step necessary to implement the agreement is to make funds available by issuing a project order. If it is necessary to modify the work package the systems command will prepare a task assignment letter (AIRTASK).

D. THE LEADING FIELD ACTIVITY

When a development requires access to technical skills or facilities of more than one field activity, the laboratory or activity performing the majority of the work or the most critical function will be recognized as the leading field activity and will be tasked with technical coordination of the entire development effort. Project management functions are an essential part of this task.

E. PROJECT MANAGEMENT CONTROL

It is the opinion of the authors that the existence of a direct command relationship between the systems command headquarters and the participating field activity is not necessarily an essential factor in the management control relationship developed under the AIRTASK concept. Control is exercised through informal telephone contact and personal visits more than by formal reporting procedures. Systems commands have an interest in maintaining and improving in-house capability for exploiting technological advances, developing hardware and evaluating weapons systems. This is

best done by providing the laboratories opportunity to participate in all phases of meaningful development programs.

F. AN EXPANDED ROLE FOR THE LABORATORIES

The failure and shortcomings of the Department of Defense systems acquisition process and a responsibility and willingness to work toward a solution was expressed by Mr. David Packard when he was appointed Deputy Secretary of Defense. In formulating a plan to improve the acquisition process, Mr. Packard stressed the need for improved management within the Department of Defense. In the area of weapon systems acquisition management Mr. Packard held a conviction that responsibility must be clarified and understood within the services. The proper role for the office of the Secretary of Defense is that of policy guidance and review and approval of service programs at key decision points. The job of managing programs is the responsibility of the services. The only way to obtain better performance in this area was to improve the management of programs by the military services. Responsibility for improvement was clearly delegated to the service secretaries.[11]

One action taken by the Department of the Navy to improve program management resulted in the assignment of responsibility for the AGILE missile development to the Commander, Naval

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[11]Department of Defense Directive 5000.1, Acquisition of Major Defense Systems, 13 July 1971.

Weapons Center, China Lake. This assignment evolved from recommendations from the various study groups to make greater use of the in-house laboratories beginning as early as the Bell Committee Report in 1962.[12] The suggestion was also advanced by the Report of the President's Blue Ribbon Defense Panel[13] and by the Report of the Task Group on Defense In-House Laboratories.[14] The Chief of Naval Operations has also advocated similar plans.[15]

The rationale behind these recommendations and the intended objectives are of interest to this study. Frequently cited has been the steady decline in the ability of the systems command functional organizations to manage programs. Loss of technical expertise has been attributed to the failure to increase manpower ceiling commensurate with the increasing technical complexity of modern weapons. The employment of engineers to perform managerial and administrative

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[12] Report to the President on Government Contracting for Research and Development, prepared by the Bureau of the Budget and referred to the Committee on Government Operations, United States Senate, 17 May 1962 (Bell Report).

[13] Blue Ribbon Defense Panel Report, Defense Industry Bulletin, September 1970.

[14] Department of Defense, Report of the Task Group on Defense In-House Laboratories, Annex A, 1 July 1971.

[15] Department of the Navy, Chief of Naval Operations Memo, Improved Research and Development Procedure, 6 Feb 1971.

functions is also a frequent complaint as is the reluctance of heads of technical branches to dedicate enough talented personnel to programs.[16] Another contributing factor has been the use of contractors to manage development programs. This was an essential part of the process during the total package procurement era that has led to the present weakness. One final factor affecting project managers is that the Naval Air Systems Command is oriented toward support of large, costly, high visibility airframe developments at the expense of smaller programs. Managers of the minor projects are at a disadvantage when competing for resources, particularly for services of technical support personnel. The smaller programs do not generate enough work to require dedicated personnel, and the engineers devoting part time effort are often removed and replaced without consulting the project manager. Frequently, when a major project runs into trouble, the manager of a small project will find that all his support from the technical branches has temporarily vanished.

Assigning management responsibility to the laboratories and field activities is expected to have a beneficial effect on their overall performance. One of the recommendations of the Task Group on In-house Laboratories was to: "Provide each laboratory with the capability of managing programs across the full spectrum of the research, development and engineering activities involved in fielding hardware subsystems

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[16] Report to the President and the Secretary of Defense on the Department of Defense by the Blue Ribbon Defense Panel, Appendix E., Staff Report on Major Weapon Systems Acquisition Process, July 1970.

and small systems in response to operational needs.[17] Also cited was the "lack of full utilization of the talent and expertise in the laboratories and the lack of enough challenging assignments to fully stimulate and motivate their people."[18]

By unifying the responsibility for technical and managerial decision making on in-house developments the participating laboratory is given the ability, within broad management guidelines, to make major decisions on the spot, free from remote meddling. Other benefits expected from increased laboratory participation include a better understanding of the cost elements of weapon systems development through analysis of the data generated by the Navy Industrial Fund accounting system. This information will also generate a standard against which to compare costs of research and development conducted in private industry. Exposure to project management disciplines on a routine basis is expected to enhance the laboratories performance as technical advisors through the transfusion into the laboratories of a greater awareness of what problems need to be solved and the mechanisms needed to carry systems through to operational status.

Briefly, these were the factors that entered into the decision to locate AGILE management at the Naval Weapons Center, China Lake. With the purposes and goals of field management of a weapon systems acquisition thus established, the stage is set for examination of the AGILE project.

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[17] Department of Defense , Report of the Task Group on Defense In-House Laboratories, 1 July 1971, p. 13.

[18] Department of Defense, Report of the Task Group on Defense In-House Laboratories, Annex A., 1 July 1971.

IV. THE AGILE DEVELOPMENT

A. BACKGROUND

With the United States' military involvement in Southeast Asia, the need for improving our air-to-air missile capability became imperative. In response to the Southeast Asia air-to-air threat, a Tentative Specific Operational Requirement (TSOR 16-23T) was issued in May 1967 for the development of a weapon system designated SHAPSHOT. Proposed Technical Approach (PTA WW16-23T) prepared by the Naval Air Systems Command with Naval Weapon Center China Lake participation responded with a short-term Sidewinder missile product improvement program. During this same period the Naval Air Systems Command funded a separate one year exploratory development effort at the Naval Weapons Center for investigation of such proposed missile concepts as QuickTurn and advanced seeker designs that eventually evolved into the AGILE, or AIM-95 program.

The Air Force offered yet another answer to the Southeast Asia air-to-air threat. The Air Force AIM-82 missile was a possible candidate system for both Air Force and Navy use. It was the Navy's position that the immediate need for a short range air-to-air missile could best be met by a modified Sidewinder with an IOC of FY 1969. The AIM-82, which had not yet entered engineering development and AGILE, which would fulfill long range requirements, were further downstream. A study, conducted jointly by the Naval Weapons Center, China Lake and Wright-Patterson Air Force Base to determine the

interim missile configuration found that the Sidewinder modification would result in appreciably lower development cost as well as shorter time to IOC.

In August 1970, joint Air Force-Navy recommendations regarding the development of air-to-air missiles for use on aircraft of both services were presented to Deputy Secretary of Defense Packard. The recommendations were that the Air Force AIM-82 program be terminated and the improved Sidewinder be developed by the Navy to meet the short term requirements of both services. The Navy would be the lead service for the AGILE missile advanced development while the Air Force would pursue high energy laser technology. The Air Force would fund the first twelve months of the planned twenty eight month Sidewinder development with monies from the cancelled AIM-82 program. These recommendations were concurred in by the Deputy Secretary of Defense and Development Concept Paper (DCP 15) for an advanced air-to-air missile was prepared in February 1970.

In approving DCP 15, the Deputy Secretary of Defense directed that, in addition to performing system definition studies and advanced development for the new dogfight missile, full consideration should be given to upgrading an existing missile as a low-risk interim step. This has remained the fallback position throughout the program.

Work on the various aspects of missile development was being performed by several functional groups at the Naval Weapons Center and at other Navy and Air Force Installations.

In April 1971, by memorandum addressed to the Chief of Naval Operations and the Chief of Naval Material, Dr. Robert A. Frosch, Director of Navy Research, Development, Test and Evaluation, directed that management responsibility for AGILE development through prototype testing be assigned directly to Naval Weapons Center, with the longer term problem of pilot line and production procurement to be accomplished jointly with the Naval Air Systems Command.[19] This assignment presented both the Naval Weapons Center and the Naval Air Systems Command with several organizational problems. While the assignment of responsibility is clear and explicit, there was not at that time, nor is there now, an organizational relationship through which the responsibility is discharged. The agreement between the Commander, Naval Weapons Center and the Commander, Naval Air Systems Command, discussed in the following section, is an attempt to define a working relationship.

In July, 1972, Dr. John S. Foster, Jr., Director of Defense Research and Engineering, approved and forwarded a revised version of DCP 15 for the AGILE Advanced Short-Range Air-to-Air Missile.[20] This action, taken with the concurrence of Deputy Secretary Packard had the effect of waiving the requirement for Defense System Acquisition Review Council

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[19] Assistant Secretary of the Navy (Research and Development) Memorandum of 26 April 1971, op. cit..

[20] Department of Defense, Deveolpment Concept Paper #15, Revision A; AGILE Advanced Short Range Air-to-Air Missile, 10 July 1972.

approval to enter the Validation Phase. Dr. Foster expressed concern for the conduct of the AGILE development and imposed a requirement for a quarterly report on the general status of the program and certain key development issues.

Validation effort thus far has been focused on demonstrating the feasibility of new concepts to be incorporated in AGILE through a program of component hardware development and testing. Although an appreciable portion of the validation effort is being conducted in-house, private industry has played an active role in component design. In high risk areas such as seeker design, parallel development has been obtained by funding independent exploratory developments be several contractors. The product of the validation phase will be the baseline missile configuration for the engineering design phase. This will be a preliminary design, expected to undergo further refinement during engineering development.[21] Based on this design however, the Navy will request approval to enter full scale development phase.

B. THE NAVAL WEAPONS CENTER-NAVAL AIR SYSTEMS COMMAND AGREEMENT

1. Background

Although the role of the Naval Weapons Center in the AGILE program is similar in most respects to that in other missile system developments in which the Naval Weapons Center acted as leading field activity, there is an important

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[21] Naval Weapons Center, Head, AGILE Development Division, Memorandum 302/WFC:lb, Serial 54, to File, Subject: TVC Missile Design, Development and Test, 19 April 1972 (Rev. 1, 25 April 1972), p. 1.

difference. The Naval Air Systems Command retains the responsibility for pilot and production procurement and all the support requirements for fleet introduction. However, the Naval Weapons Center has been given responsibility for "design and development through prototype test and evaluation."[22] This responsibility goes beyond the Naval Weapons Center's familiar function of technical direction. Management of AGILE will require a great deal more managerial acumen than that required in any single program at the Naval Weapons Center to date. AGILE is a major weapons system acquisiton in the eyes of the Office of the Secretary of Defense and, as such, can expect high visibility exposure at all levels of government.

In line, perhaps, with the current Department of Defense philosophy of decentralized, participative management, Dr, Frosch, in assigning responsibility for AGILE, did not specify the management techniques or mechanisms to be used in implementing the program. The task of developing a systematic managerial approach for AGILE was left to the Naval Material Command and the Naval Weapons Center. In recognition of the problems inherent in the divided management responsibility imbedded in the arrangement prescribed by Dr. Frosch and the need for a clearer understanding of the working relationships involved, the Commander, Naval Air Systems

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[22] Assistant Secretary of the Navy (Research and Development) Memorandum of 26 April 1971, op. cit..

Command entered into an agreement with the Commander, Naval Weapons Center for the Advanced Development and Prototype Test and Evaluation Programs for AGILE missile weapon system. This agreement is included in Appendix B. The agreement specifies the organizational relationships to be used by AGILE management and details the responsibility for the various project management tasks to be accomplished. The assignment made in Dr. Frosch's memorandum[23] was rather vague as to the reporting relationships intended. Even the obvious question of who the Naval Weapons Center was to be responsible to for AGILE was not answered. The agreement places the Naval Air Systems Command directly in the chain of authority for all phases of the program.

2. Specified Organizational Relationships

Figures IV-1 and IV-2 diagram the management relationships between the Naval Air Systems Command and the Naval Weapons Center as envisioned in their agreement on the AGILE program. The relationship established by the negotiated agreement links the Commander, Naval Air Systems Command and the Commander of the Naval Weapons Center in the same manner as other development programs. Through this agreement, the Commander, Naval Weapons Center is responsible to the Commander, Naval Air Systems Command for the functions specified in the agreement.

Project management business and communications flow

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[23] Ibid.

through the channels indicated by light solid lines in Figure IV-1. This is envisioned as the main link between the Systems Command and the Weapons Center and through the Weapons Center to the other field activities or contractors in the AGILE program. The Project Coordinator/Manager in the Naval Air Systems Command and the Development Manager in the Naval Weapons Center organization are equal and mutually supporting positions. During the phases of the development program when the Development Manager is directly controlling the design effort, the responsible Naval Air Systems Command officer will be known as the Project Coordinator and will provide liaison with higher authority in connection with AGILE management and progress reporting. The staff and support personnel will act as consultants as required by the Naval Weapons Center Development Manager. At the time AGILE is released to pilot production, the Project Coordinator is to assume Project Manager status and primary responsibility for all portions of the project. The Project Manager/Coordinator does not enter directly into the decision process during the development phases but he is specifically charged with the responsibility for program validation through in-process reviews.

The command relationships indicated by heavy solid lines in Figure IV-1 clearly indicate that the Commander of the Naval Weapons Center is in the AGILE management chain-of-command. In actual practice, the AGILE Development Manager reports several echelons below the level of the Commander.

MANAGEMENT DIAGRAM FOR AGILE GUIDED WEAPON SYSTEM DURING THE ADVANCED DEVELOPMENT AND PROTOTYPE ENGINEERING TEST AND EVALUATION PHASES

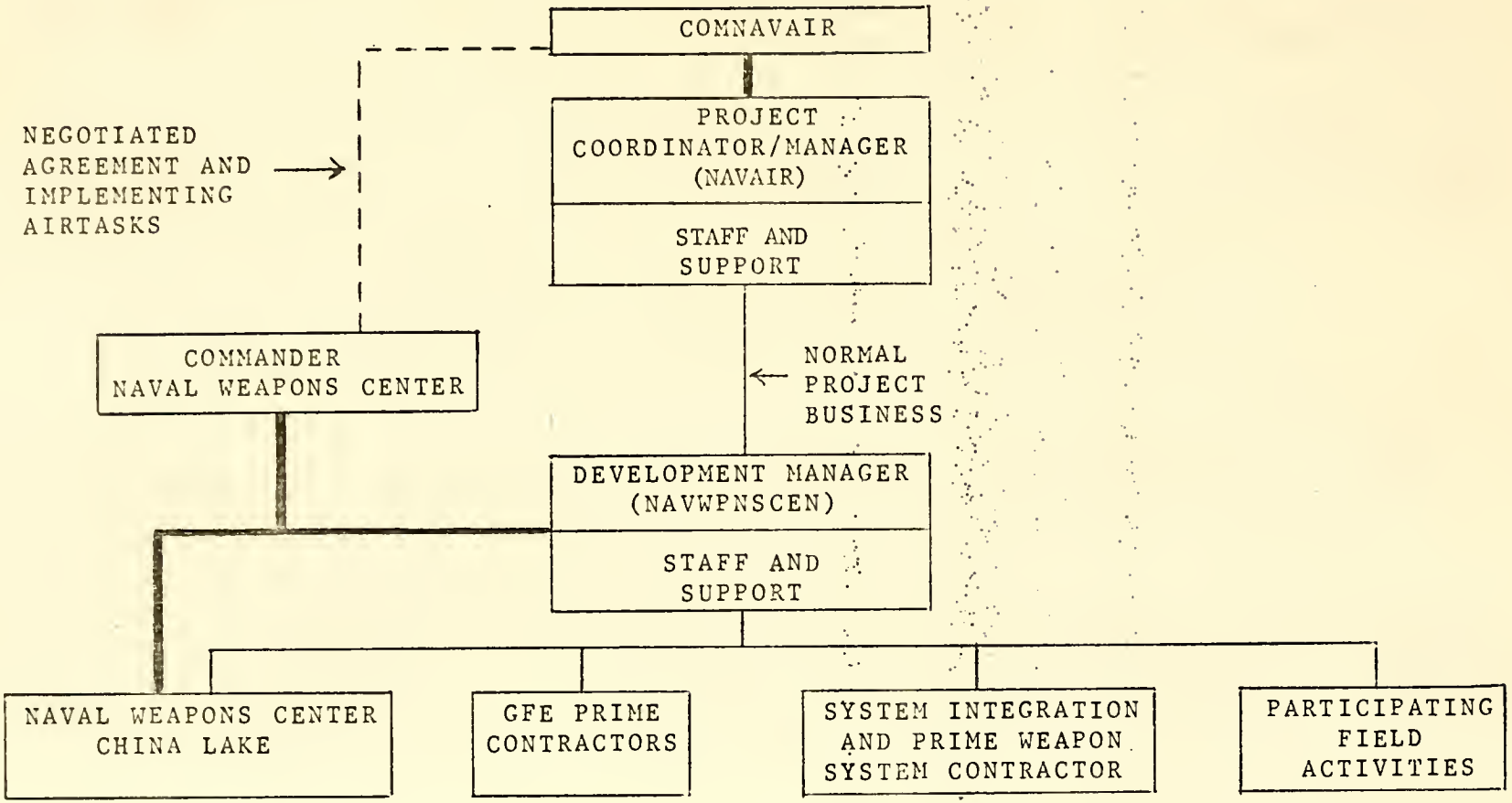

FIGURE IV-1

NAVAIR-NAVWPNSCEN
AGILE PROGRAM
MANAGEMENT

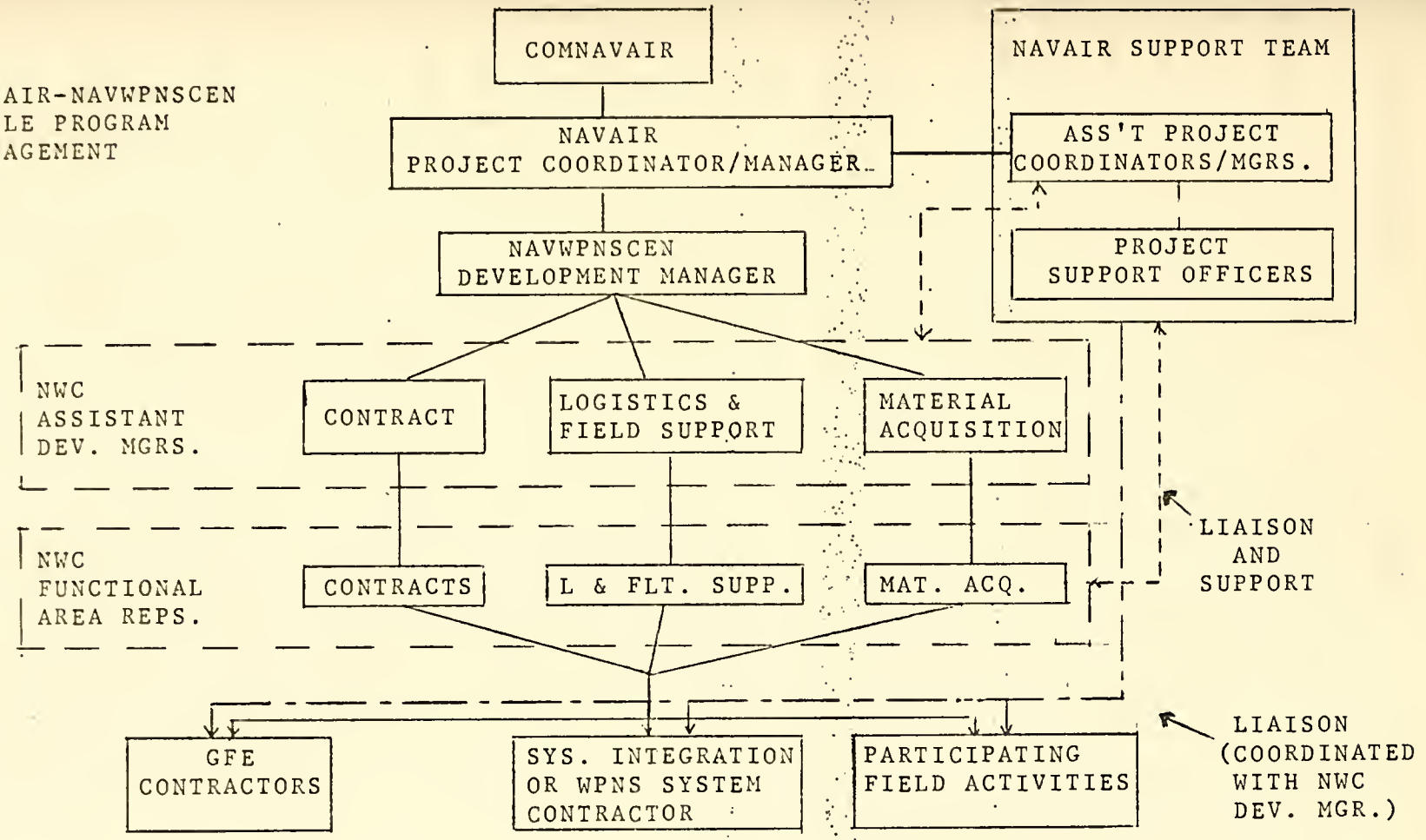

FIGURE IV-2

This reporting relationship, shown in Figures IV-3 and IV-4, will be seen to have important bearing on the conduct of the AGILE program. Figure IV-3 shows the Naval Weapons Center internal organization for AGILE management as it was originally established. Figure IV-4 shows the same organization after re-alignment of AGILE Branches in November 1972. These slight changes reflect changing management concerns as the AGILE program matures.

The product and functional organizational relationships diagrammed in Figure IV-2 should, in the opinion of the authors, be phased in by this point in the AGILE development. The NAVAIR support team has not been fully staffed. This could be easily corrected because the organization envisioned is compatable with NAVAIR's normal operating procedures. The organization called for at China Lake would be more of a problem. It replicates the Naval Air Systems Command project/functional interfaces and requires internal organizational change. These changes have not been made.

3. Naval Air Systems Command Functions

Under the terms of the NAVAIR-NWC Agreement the Naval Air Systems Command remains responsible for the development, production and support of the AGILE Weapon System. Specific functions reserved for the Project Coordinator and other NAVAIR personnel are long range planning, preparation, review and justification of programming, budget and apportionment estimates for the total AGILE Program, validation of the prototype data package, configuration control and liaison with CNM, OPNAV, SECNAV, OSD, and Congress.

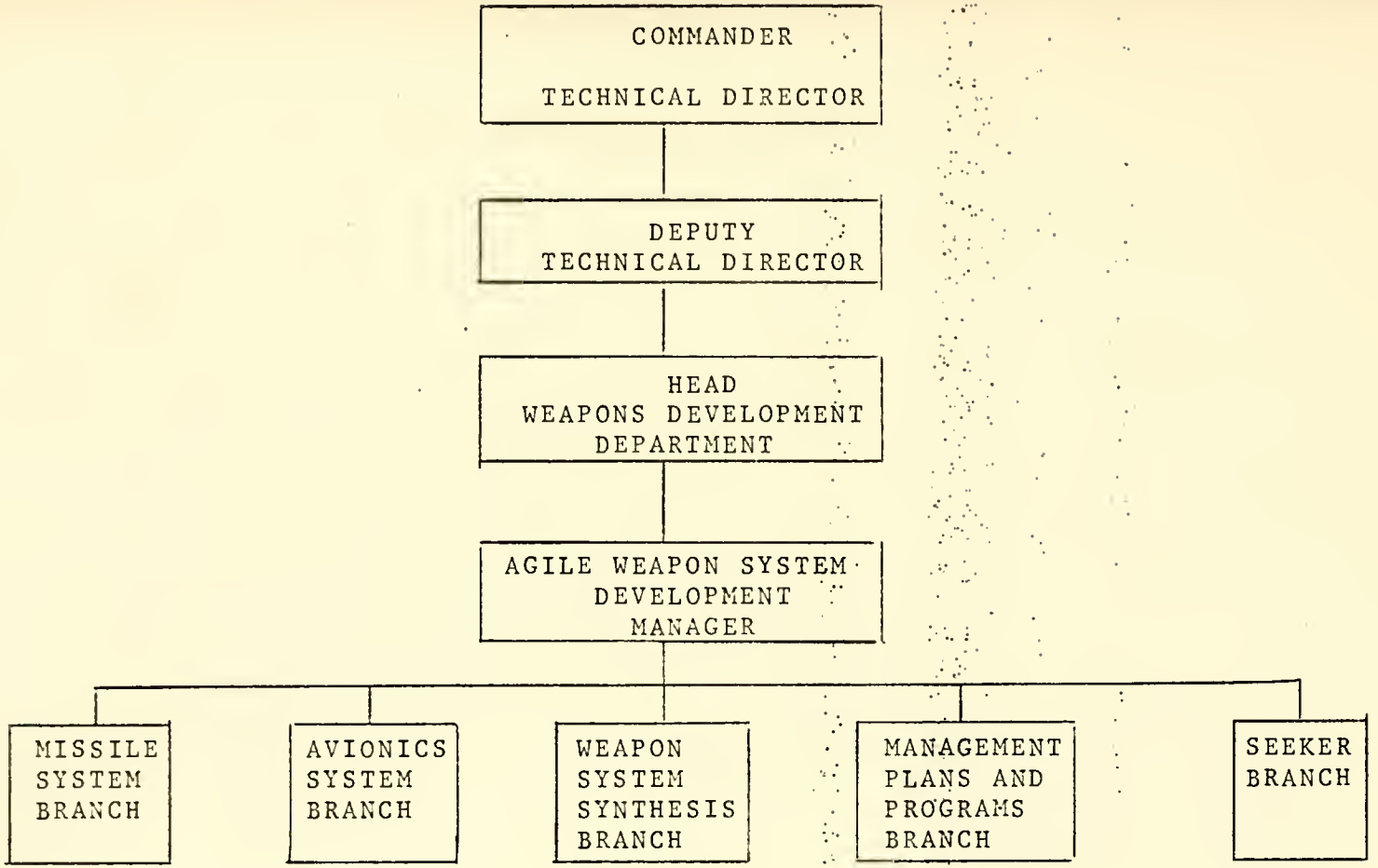

FIGURE IV-3. ORIGINAL NWC AGILE ORGANIZATION

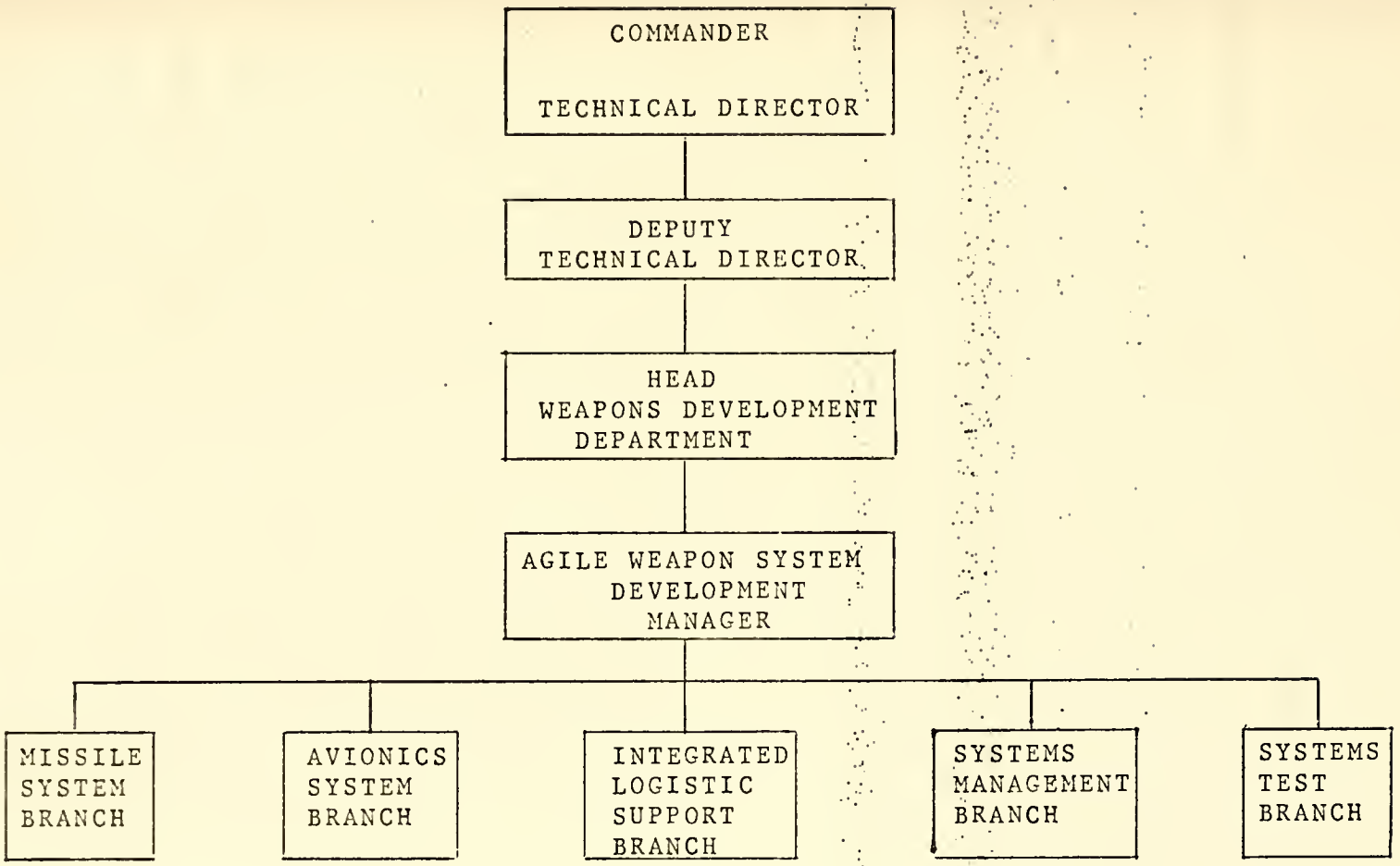

FIGURE IV-4. NWC AGILE ORGANIZATION

4. MANAGEMENT FUNCTIONS ASSIGNED TO THE NAVAL WEAPONS CENTER

The Naval Weapons Center is responsible for financial management for assigned portions of the program, preparation and updating of program control documentation, contracting for all procurements undertaken in support of the development through prototype phase, final selection of contractors for prototype production subject to approval by higher authority, and intra-project and inter-service liaison. Liaison with aircraft and related equipment contractors will be arranged by the Project Coordinator. NWC also performs cost estimating, integrated logistics support management and makes progress and technical reports as required by the Naval Air Systems Command.

C. CURRENT STATUS

1. Progress in Technical Areas

The AGILE program is in the later stages of Advanced Development and the time for a decision to proceed to Engineering Development is rapidly approaching. Preparation for DSARC II involved a considerable amount of hardware test and evaluation, simulation studies and trade-off studies to arrive at an engineering baseline missile design. Due to recent decreases in Navy research and development funding, work schedules have been revised. The scope of the test and evaluation program has been decreased and scheduled completion has been postponed. Due to the fluctuations in current funding and its impact on program schedule, an exact

definition of AGILE's position in the acquisition cycle is not possible. It is sufficient to note that its current status would lend a feeling of urgency to all efforts associated with the program

A unique element in the AGILE program is the formal technical review conducted in-house by the Naval Weapons Center as a precondition for approval for engineering development. This review by the NWC Design Review Committee will logically be conducted prior to DSARC II and will examine two areas that are DSARC concerns: the feasibility of the proposed AGILE design approach and the adequacy of the engineering baseline missile design.

2. Management Emphasis

In contrast to the in-house review the milestone DSARC review (DSARC II) and an interim Management Review held the week of 4 March 1973 placed heavy emphasis on program management considerations. At the time for DSARC II, AGILE management will be required to address specific program parameters such as unit production costs and life cycle costs, maintainability, supportability and other Integrated Logistic Support elements.[24] However, the emphasis being placed on program management is best demonstrated by two OSD initiated demands. The first is a requirement for a quarterly progress report to the Director of Defense Research and Engineering on key program management issues. The second is the

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[24]DCP 15, op. cit..

previously mentioned management review. The intent of the latter review is to evaluate the way the Navy is conducting this development and, due to the way the AGILE program management has been structured, NWC China Lake will receive most of the attention.

3. Industry Participation

The AGILE Technical Development Plan and other program planning documents contemplate extensive industry participation in both Advanced Development and Engineering Development. Industry has played a major role in the design of system and sub-system components under the guidance and technical direction of the NWC. In areas of high risk, several promising developments have been funded on a competitive basis for industry development independent of the NWC design efforts.

AGILE planning calls for the selection of a single contractor to act as principle support contractor during the latter states of Advanced Development. The principle support contractor will be the prime contractor for the missile guidance system and will assist NWC in preparing for Engineering Development and during that stage will be tasked with the systems integration responsibility. The principle support contractor will be responsible for integrating the design efforts of prime and sub-contractors to achieve a low cost, producable design. The Request for Proposals (RFP) for this contract was issued by the Navy Regional Purchase Office Los Angeles on 15 September 1972. Five contractors submitted proposals. The source selection process currently underway has

narrowed the field to two. Source selection evaluation board consists of personnel from the Naval Weapons Center, Naval Weapons Test Center, and the Naval Air Systems Command. Source Selection Advisory Council members include NAVAIR representation but final selection authority is retained by the Chief of Naval Material.

4. The Naval Air Systems Command Role

Under the terms of the agreement between the Naval Air Systems Command and the Naval Weapons Center, NAVAIR retains responsibility for the AGILE program but its role in the management of the program at this stage in minimal. The main NAVAIR responsibility is assuring that the thresholds, program directions and other requirements imposed by higher authority are observed. The way this responsibility is carried out varies with the circumstances. An officer in the NAVAIR Material Acquisition Division, identified as the project coordinator nominally has this responsibility. He is assigned to the Air-to-Air Missile Branch and is the only individual who is assigned exclusively to the AGILE program. He functions without staff, charter, nor the visibility of an identified project manager. His task is made difficult by the lack of clearly defined communications channels. There is no systematic reporting of program data. Information is obtained on an as needed basis.

Under the concept set forth in the NWC-NAVAIR agreement, the AGILE development manager at NWC reports directly to the AGILE program coordinator in NAVAIR. The normal flow of

technical information through project support officers in various functional branches is bypassed. The NAVAIR functional divisions are available to act in a consulting capacity with technical direction originating in the China Lake organization. In the opinion of the authors it is not surprising to find that China Lake, given the opportunity to function independently, has foregone such support and the attendent risk of NAVAIR-imposed constraints.

5. The NWC AGILE Project Organization

The Naval Weapons Center has evolved a management program for the AGILE program that is fully integrated in their existing organization. The Development Manager reports to the head of the Weapons Systems Development Department. He has line authority over the branches dedicated to AGILE but depends in part on the support of the functionally-organized departments of the Naval Weapons Center. The NWC AGILE program organization is best described as a hybrid project-matrix adapted to the Weapons Center's traditional ways of doing business. The position of the development manager within the China Lake organization does not allow him full authority over program decisions. The investigation disclosed that program technical decisions are on occasion made by higher echelons of management.

The Development Manager in practice performs the functions of technical manager of the AGILE project. The individual assigned to the job has excellent qualifications as an engineer and technical manager but little experience with

acquisition program management as contrasted to technical management. He has relied heavily on the Project Management Plans and Programs Branch for this function.

Since the AGILE project was staffed from personnel already employed at China Lake, the individual initially assigned as head of the Project Management Plans and Programs Branch was also an engineer with greater technical than managerial qualifications. The history of project management can be divided into two distinct periods: the first period beginning with the inception of AGILE at China Lake, ended with the replacement of the head of the Project Management Plans and Programs Branch in November 1972. The second period begins with the appointment of an experienced procurement oriented manager to the position.

During the first period, project management was essentially viewed as a record keeping and accounting process. The head of the Project Management Plans and Programs Branch functions on the same level as the other branch heads reporting to the AGILE division head. The position did not carry with it the authority to manage program funds. Each branch head exercised this authority for his branch independently under general guidelines laid out by the Development Manager.

One rather surprising aspect of AGILE management at China Lake is the relegation of the majority of contact with outside agencies to the Management Plans and Programs Branch Head. It is the authors' opinion that this has come about

because the Development Manager is so strongly oriented toward the technical disciplines. In practice the AGILE Management Plans and Programs Branch Head has been handicapped in dealing with outside inquiries by his lack of authority to make program commitments of any significance.

During the early period of AGILE's existence at China Lake as a full-fledged program, roughly from April 1971 to November 1972, the individual assigned as head of the Management Plans and Programs Branch was an engineer with little experience or exposure to the broad concept of project management. He accepted the assignment with the understanding that he would have to "learn the ropes" as the program progressed. The fact that he did not fully realize the scope and importance of many of the program management elements and disciplines is not surprising. As a consequence, the information needs of higher authority were seldom anticipated. Inquiries and requests for information such as impact statements invariably touched off a flurry of activity which, quite naturally, inconvenienced and annoyed other branch managers. It was obvious that a qualified manager was a vital necessity for AGILE success.

The present head of the Management Plans and Programs Branch, now titled the Systems Management Branch, has qualifications based on a military career in the weapons system acquisition field. He has brought to the job a systems approach to project management. He is aware of the many requirements imposed on project management, appreciates their

significance and interrelationships. His most valuable contribution to the program thus far is in the area of planning. The integration of the many local planning functions in a master program plan allows the establishment of a data collection and reporting system that provides accurate and current information. The introduction of a computer-based Management Information system in the last several months has proceeded at a rapid pace. Its implementation and acceptance is aided appreciably by the System Management Branch Head's efforts to obtain cooperation of the branch heads. His personal stature is such that he exerts appreciable influence in the AGILE program well beyond the limits of his authority. He has the talent of anticipating the needs of NAVAIR and realizes the importance of a close working relationship with AGILE organization. The results of his effort are beginning to be realized in many important areas. The most recent achievement was successful outcome of the OASD management review of AGILE management. The review, conducted in early March, indicated confidence in AGILE program management under the present concept.[25]

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[25]These statements represent the opinions of the authors based upon personal observation and interviews conducted during a three month period before and a three month period after a management trained project Plans and Programs Branch Head was employed. This individual, who brings more than fifteen years experience in government procurement and systems development to the position, has instituted systematic control and reporting procedures throughout the project. The author's opinion concerning his personal influence is based on an observable improvement in the attitude of AGILE program branch heads toward managerial tasks and the Systems Management Branch between the two periods of observation.

V. AGILE EVALUATED

A. INTRODUCTION

On 26 April 1971, the Assistant Secretary of the Navy for Research and Development released a memorandum which set forth his decision to place the management responsibility for the development of the AGILE missile through engineering development at the Naval Weapons Center, China Lake. This action constituted a change to the usual weapon systems acquisition process in the Navy in which the sponsoring systems command exercises overall responsibility for program management. The change created a new set of program management requirements in addition to those normally encountered. The new management concept required action to be taken at the Naval Weapons Center and at the various Navy commands concerned with the systems acquisition process. AGILE program management will be evaluated on the basis of how well these requirements were met. Specific management plans, decisions and actions considered important and necsary by the authors will be used as a basis for evaluation. Within this framework, the management criteria specified in Chapter I of this paper will be applied in examining AGILE management's performance.

The management functions of planning, organizing, staffing, control, communicating and directing will be looked at on the Navy headquarters level as well as at the working level at China Lake. Although the effect of decisions made at the Office of the Secretary of Defense help shape the course

of the AGILE program, this study will treat them as external constraints and confine itself to Navy management effectiveness.

Within the Navy, the offices and agencies found to exercise the greatest control and influence in matters concerning AGILE were the Office of the Assistant Secretary of the Navy for Research and Development, the Naval Air Systems Command Headquarters and logically, the Naval Weapons Center, China Lake. The focus of this evaluation is these three organizations.

During this discussion, frequent reference is made to information and opinions learned during interviews conducted by the authors. In most cases it proved impossible to document the data obtained in this way. The value placed on opinion is a matter for individual judgement in each case and the statements of opinion are included to provide a feeling for the managerial climate of the AGILE project, not for their intrinsic worth. In a surprising number of cases, the views expressed were shared by a number of knowledgable Defense officials. A complete list of all officials interviewed in included as Appendix A.

B. PLANNING FOR CHANGE

In the opinion of the authors, a detailed plan for implementing decentralized project management was a prerequisite for AGILE's new management structure. Planning for any change is a necessity. Because there is no

precedent in which AGILE management can find guidance, even more intensive and careful planning was indicated.

Planning for a change is a two sided effort. First, the policies, procedures and organizational modifications necessary to implement the change must be developed. This requirement will be covered in a subsequent section. The second part of the effort is the planning necessary to ensure that the change will be accepted within the organization. Change, unless its objectives and effect on individuals and working groups is understood, will be resisted. Understanding is the key to avoiding resistance to change. Policies and objectives should be disclosed in such a manner that the personnel responsible for implementing them at the working level can understand and identify with them. People who will be strongly affected by the change should have a voice in formulating the plan of action. Planning for the AGILE program should have been accomplished with the participation of working level personnel in the Naval Air Systems Command and the Naval Weapons Center.

The objective and intent of the decision to place AGILE management in the field was never clearly stated. The overall objectives of the change, as understood by the authors based on interviews with program officials, are still not entirely clear, nor are they documented. In interviews and in the study of AGILE program documents, no evidence was discovered that an attempt was made to explain the rationale of the decision to the personnel who would be affected, nor

to involve them in planning for the changes to come. Mr. H. D. Wilson, Technical Director of the Naval Weapons Center, for example, was unable to provide the authors with an explanation. This circumstance supports the authors' contention that the people who were to carry out the decision were not privy to its formulation nor its intent.

The decision to place management of the AGILE development at the Naval Weapons Center could be expected to, and did meet with resistance at the Naval Air Systems Command Headquarters. The AGILE program had existed in the conceptual stage in the Naval Air Systems Command Research and Technology Directorate and was being supported by the functional divisions of the Material Acquisition Directorate. The decision encroached upon the traditional prerogatives of the systems command, threatening to erode its authority over an important program. Implicitly, the decision acknowledged the diminishing technical competence of the NAVAIR functional divisions and threatened to further degrade that ability. The planning and implementation of the change should have included an effort to gain greater understanding and support in the Naval Air Systems Command.

Part of the process of planning is the selection of program goals and objectives and determining the criteria to be used in the decision making process. By allowing working level managers charged with responsibility for achieving those goals to participate in the planning process, their understanding and support is assured.

C. PLANNING FOR DECENTRALIZATION

Current Department of Defense policy is that the responsibility and authority for the acquisition of major defense systems be decentralized to the maximum practicable extent consistent with the urgency and importance of each program. The AGILE program is an attempt at decentralization with much of the decision authority vested in the working level personnel at China Lake. Its unusual structure and lack of precedent has given management the right to deviate from broad DoD guidelines. The need for flexibility is patent.

One possible objective of the AGILE program management structure mentioned during several interviews was to by-pass the layers of authority that comprise the Navy's acquisition management establishment, thus pushing the decision-making responsibility to the lowest practicable working level. On the surface, the AGILE mode of project management appears to do this. Secretary Frosch's memorandum seems to create a decentralized management structure by simply cutting AGILE's ties to the NAVAIR technical and functional branches. Decentralization, however to be practical, requires something more. The decision to decentralize should be based on comparison of the advantages and costs of decentralization and a carefully formulated plan for implementation.

It does not appear that this question was treated in a systematic way in the AGILE program. The apparent advantages and benefits of laboratory program management is documented

by numerous studies.[26] The logic of in-house engineering development was noted repeatedly during interviews with Navy managers and research personnel as well. However, no attempt has been made to quantify the gains expected or the costs involved.

As stated in the introduction four essential steps must be taken when decentralizing authority and responsibility: functionalization of planning and control; determining precise lines of authority and responsibility; clear definition of how managers at lower levels can participate in planning and developing methods of control which are adapted to the need for coordinated action in a decentralized organization. The only program document discovered that addresses any of these planning functions is the Naval Air Systems Command - Naval Weapons Center working agreement. It clarifies authority relationships to a certain degree. The three remaining requirements are left unsatisfied.

D. ORGANIZATION AND STAFFING

When the functions and responsibilities of the billets in an organization and their relationship to other billets and functions are clearly defined, there is little opportunity for personality clashes to impede the routine flow of

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[26] The Report of the Task Group on Defense In-House Laboratories in 1971, Appendix E to the Blue Ribbon Defense Panel Report in 1972, the Defense Science Board Task Force on R&D management in 1969, and the Bell Report in 1962, for example, contain arguments favoring in-house development.

work. Conversely, when jobs are ill-defined, misunderstandings are frequently a cause of conflict. The AGILE program did not fit into the existing organizational structure and depends to a large extent on a spirit of cooperation to avoid conflict. This situation arises because functional responsibilities concerning the AGILE program were not clearly defined at the outset.

The problem has not been completely ignored. An attempt to clarify authority and responsibilities resulted in the COMNAVAIR-COMNAVWPNCEN Agreement Concerning the Advanced Development and Prototype Test and Evaluation Program for AGILE Guided Weapon System. The text of the agreement is included as Appendix B. The agreement is not in itself a complete plan for the conduct of the AGILE program. It established policy and guidance to be used in formulating a management plan. Since the AGILE program had no precedent, existing organizational relationships were modified to meet current needs. The modifications, made for the express purpose of satisfying ASN(R&D) requirements, were minimal. The drafters of the agreement maintain that where it appears to be vague or ambiguous, it is so of necessity.[27] The participants in the AGILE program would need latitude in resolving problems as yet unforeseen. Inflexible provisions acting as constraints on AGILE management would weaken the program.

Under the terms of the agreement, the Naval Air Systems Command retains responsibility for coordinating long-range planning for the AGILE program, including primary liaison with

Congress, the Office of the Secretary of Defense, and higher echelons of Navy command. A Program Coordinator has been designated to act as a point of contact for all inquiries concerning AGILE. He is the AGILE program spokesman in the Washington arena. He coordinates the headquarters management function for AGILE. Although this is a task of considerable magnitude, the Program Coordinator is the only individual serving AGILE in a dedicated billet in the Naval Air Systems Command. In actual practice, the billet has not proved effective. The Program Coordinator is hampered by insufficient staff support. He does not have convenient access to program data necessary to the performance of his liaison function. He has not exploited informal contacts to compensate for his lack of formal organizational authority. The billet does not have the official status of a chartered project manager and is frequently bypassed in the press of urgent program decisions.

Department of Defense Instruction 5000.1 expresses concern for the assignment and tenure of program managers. Program managers are to be given certain career incentives and will remain in their billets long enough to be effective. The program manager must feel responsibility for and be held accountable for the downstream effects of his management decisions. The way the AGILE development is structured makes this an impossibility. No one individual is clearly responsible for the AGILE program at this point and a project manager, when chartered, cannot be held accountable for the results of decisions being made now.

The problem lies in the concept of the Program Coordinator billet. At the time AGILE enters full scale production, the Program Coordinator will be designated as AGILE Project Manager. An individual with the drive and determination to be a successful project manager would naturally be dissatisfied with the more passive role of the Program Coordinator. Knowing that he will eventually have responsibility for the outcome of decisions being made at China Lake, he will attempt to influence them and AGILE management at China can be expected to resent his intrusion. The Program Coordinator has very little authority over the AGILE decision-making process and no authority to make program commitments. His effectiveness depends on his ability to persuade and influence managers currently in positions of authority.

The NAVAIR Program Coordinator's position would be unsettling to management scholars. The organizational structure of the AGILE program at China Lake would be no less so. The AGILE organization at China Lake is a hybrid organization heavily oriented toward the project/product organizational form. The AGILE Development Manager reports two levels below the level of the center Technical Director. One of the four branches reporting to the Development Manager is now responsible for overall coordination of the AGILE business management effort. The precise number and nature of the billets in this branch has varied over the life of the program as the concept of its functions changed. Gradually,

responsibility for interfaces with all activities outside China Lake has shifted to this office. In the past the function of this branch was limited to fiscal accounting and record keeping. Its role in planning and control has resulted from a gradual evolution.

To function properly the head of the systems management branch must have authority to direct that actions taken by other line branch heads conform to the program management plan. Since he is at the same level in the organization, he has no line authority to do this. He must depend upon the informal organization to achieve his goals. The authors believe that there should be a Project Manager with clearly defined formal authority to perform these functions.

The assumption of AGILE management responsibility imposed unique additional staffing requirements of the China Lake organization. In the opinion of the authors, provisions for new billet requirements and changes to the organizational structure left much to be desired. Detailed plans for transition should address personal and organizational requirements as well as the technical aspects of the program. In planning for decentralized operation it is imperative that the skills and competence of the subordinate managers be determined and, where necessary, improved prior to execution of the decentralization plan.

It is a policy of the Department of Defense that the development and production of a major defense system shall be managed by a single individual chartered with sufficient

authority to accomplish program objectives. If that individual is a competent manager, many of the problems of program management will be avoided. The AGILE development is not structured to take advantage of a good manager's talents. Authority and responsibility are fragmented. A change in management is built into the program at the critical point where production is initiated. The fact that no individual has been chartered as AGILE Project Manager is, in the opinion of the authors, a major weakness. A charter setting forth authority and responsibility, issued by high authority would provide sure footing for the AGILE manager in dealing with the conflicting demands of those agencies having interest in AGILE. The authors believe that the chartering authority for AGILE should be the Chief of Naval Material. A program manager reporting at that level would be able to resolve questions of concern to both the Naval Air Systems Command and the Naval Weapons Center while still preserving the integrity of the existing chain of command and channels of communications. Chartering by the Chief of Naval Material would have the added advantage of conforming to another principle set forth in Department of Defense Instruction 5000.1. That is the requirement that layering of authority between that program manager and the service component head be kept to a minimum.

E. CONTROL

One of the essential factors in decentralization is the development of a control system that is adaptable to

management's new needs. The shift of AGILE management from NAVAIR to NWC China Lake created a need for different control procedures. How management performance is to be measured and by whom is one question that must be determined. Control of funds and expenditures is yet another.

In the normal acquisition project, the designated Project Manager, with the guidance of the chartering authority, would be responsible for detailed control of program progress. The Project Manager keeps tight control of program funds. Expenditures are tied to project work packages and are closely monitored by Program Support Officers assigned to the project. In the AGILE program, this headquarters control has been bypassed.

All AGILE funds are under the control of NWC China Lake. Responsibility for management of the development has clearly been assigned to NWC but the ultimate responsibility for the AGILE program still rests with NAVAIR. It is only logical that some control is required at NAVAIR headquarters. The system that has been established depends primarily upon the forwarding of routine project reports used by the NWC Development Manager and supplementary information furnished to the NAVAIR Program Coordinator on request. The information flow has not been adequate to NAVAIR control needs.

The lack of strong control procedures requires some compensating mechanism if the program is to succeed. A system that coordinates the diverse requirements and inputs and forces resolution of conflicts while still acknowledging the

"independent" status of the parties to the NAVAIR-NWC agreement is needed. Experience indicates the need for continued top-level management involvement.

Perhaps the device employed in the CAPTOR program would be the answer for AGILE. CAPTOR is similar to AGILE in that the management of the program was relocated from a systems command to a laboratory. Difficulties were encountered because of the number of offices and agencies with interest in the program. Inability to achieve a unified position on program issues and to coordinate the inputs of the various organizations led to problems at the working level. The problem was solved by focusing additional high-level management attention on the program through the formation of the CAPTOR Steering Committee composed of high-ranking Navy officials. Such a system, although possibly inefficient in the use of managerial time, has contributed immeasurably to CAPTOR's progress. Because the AGILE program does not cross as many organizational lines, a steering committee at a lower level might prove effective. The main obstacle to the formation of such a group would be the geographical distance between China Lake and NAVAIR headquarters.

Internal control in the AGILE program has always been adequate for Naval Weapons Center requirements. It is being tightened as a result of recent budget cuts. Flexible budgeting and close control of task assignments utilizing the detailed work breakdown structure are being instituted effectively.

F. COMMUNICATING AND DIRECTING

In the usual Navy systems acquisition program, the project manager obtains support requirements from the various functional divisions and branches in the supporting systems command. Each functional organization designates a program support officer to act as primary point of contact for the project within that functional area. The program support officer coordinates all project requirements within his functional area, including technical supervision of tasks assigned to industry or in-house research centers. The link between the program support officers and their counterparts in the laboratories and research centers forms the primary communications channel for the conduct of routine project business. It also provides the headquarters command with a readily available source of project information.

This usual interface between NAVAIR and NWC China Lake through which the two-way flow of information is conducted has not been established in the AGILE program due to the direct delegation of authority to the NWC. No new system was planned to take its place because, in theory, none was needed. All communications were intended to flow between the Development Manager at China Lake and the Program Coordinator at NAVAIR with the latter acting as the link between AGILE management at China Lake and higher echelons of Navy management.

Because this link has been inadequate for the information demands, the Systems Management Branch Head at China Lake

maintains informal communications with numerous individuals and agencies at the headquarters level. The Program Coordinator at NAVAIR is frequently by-passed completely in these exchanges. While this mode of operations allows NWC China Lake to expedite management tasks, it has certain drawbacks. The real need for exchange of information has not been met in a timely and satisfactory manner. Demands for information consume an ever-increasing amount of managerial time and attention. Key people at China Lake are spending too much time traveling to Washington meetings and briefings. Bypassing the established organization without creating a compensating communications network violates the management principle of unity of command.

To be effective, communications have to be accepted. People will ignore or misunderstand a message that is in conflict with their objectives. Since the objectives of the Naval Air Systems Command and the Naval Weapons Center are not in complete harmony with the decision to decentralize program management, communications have suffered. However, top level management in both organizations appear to be determined to make the program work. The "brute force" of top management involvement is being brought to bear in order to bring the program in line with current requirements.

VI. CONCLUSIONS

The decision to place management responsibility for the AGILE missile development at the Naval Weapons Center, China Lake had several objectives not directly related to the task of creating a new weapon system. These included improving the center's managerial capabilities, learning more about development costs, and experimenting with decentralized management. As far as the missile itself is concerned, it was hoped that the decentralization would expedite the achievement of an initial operating capability. The program's success in meeting these objectives will remain undetermined until its conclusion.

Management of the AGILE development at China Lake is a large departure from the way weapon systems acquisitions have been managed in the Navy. The Naval Air Systems Command-Naval Weapons Center working agreement is evidence that some planning for the change was undertaken. However, it is doubtful that the significance of the change was fully appreciated in the planning stage. The agreement recognized the differences between customary program management and AGILE management but, never-the-less, attempts to force AGILE management to conform to the existing organizational relationships, program structures, etc. In concept, AGILE comes very close to true decentralization of management and, management theory requires basic changes in staffing, control and communications if decentralization is to work. Failure to prepare for and institute these changes at the outset is one cause of present program management inefficiency.

An important lesson to be learned from AGILE is that any change must be carefully planned and introduced only after carefully laying the groundwork for the new way of operating. Of particular importance is assuring that the goals of the organization and the individuals are compatable with those of the project. One finding of this study is that Naval Weapons Center personnel do not in general wish to be burdened with the details of project management. Fascination with technical details and an aversion for the mundane "business" of project management is a typical and desirable characteristic of research personnel. However, faced with the task, effort should be made to identify and employ personnel with managerial talent and interest in program supervision.

The NWC China Lake AGILE organization is not structured to achieve program objectives efficiently. The authors believe that an AGILE project manager reporting to the NWC Technical Director should head the NWC AGILE program. The project manager should have clear and undivided authority over all AGILE program management and technical matters. The authors believe that the position of the Systems Management Branch Head in the NWC AGILE organization is a major organizational shortcoming. If one accepts the premise that financial constraints are the controlling factor in the current weapons systems acquisition environment then the project organization should take this fact into account. The authors recommend that AGILE be directed by a chartered project

manager. As an interim measure, it is recommended that the position of the Systems Management Branch Head be elevated to that of a manager with direct line authority over AGILE technical branch managers. The discipline of program funding constraints would thus be imposed on technical decisions.

The AGILE management concept led to conflict with the aims and goals of the Naval Air Systems Command organization. It was very much evident in the interviews conducted at NAVAIR headquarters that officials in positions of authority believed that AGILE management should remain in the systems command. Consequently, there was no strong motivation at the working level within the NAVAIR organization to make the program a success. To counteract the effects of these beliefs on organizational motivation, strong affirmative action by top management is necessary. Early, positive support for Dr. Frosch's decision if demonstrated by NAVAIR leadership could have stimulated development of efficient working relationships throughout the program.

When the time comes to pass final judgement on the effectiveness of the Navy's conduct of the AGILE program, the appropriate criteria, or at least one of the standards that should be used, will be the cost-effectiveness of the weapon system. At that time it must be realized that the present experiment with decentralized management must involve certain costs. Whether the additional costs stem from untried methods or inexperienced managers, they will be a burden to the AGILE missile development program. Hopefully, those whose

duty it is to judge these matters will take this additional burden into consideration.

It is the opinion of the authors that the AGILE program as it exists today will achieve its objective. The program successfully passed a management review presented to the Director of Defense Research and Development and other DoD officials during the first week of March, 1973. Management is meeting the requirements placed upon it, however, it is inefficient and will continue to be so long as it operates in violation of the generally accepted management principles previously discussed.

Other reasons for this optimistic attitude lie outside the realm of project management. There is a valid military need for a short range air-to-air weapon and Navy management exhibits determination to succeed on this project. In recent months, more and more high level management attention is being focused on the AGILE program. If enough support is generated and enough resources are made available, success is assured. The question of efficiency still remains.

There are strong arguments favoring this innovative approach to project management. The Navy will not improve its management of acquisition programs unless it is willing to try new management schemes. On the other hand, the existing weapons systems acquisition process is effective if not always efficient. The organizational relationships, methods, and procedures that are the cumulative result of almost thirty years experience in modern systems development are an

asset that must not be cast lightly aside. It is a serious and costly mistake to change the existing system unless it is expected that the benefit of the change will exceed the cost. All levels of management must accept the fact that costs, in terms of disruption of established organizations and traditions as well as dollars, are necessary for progress.

On the balance, the reasons for keeping AGILE project management at the Naval Air Systems Command headquarters are convincing.

APPENDIX A

INTERVIEWS CONDUCTED

1. Interviews held at Naval Weapons Center, China Lake from September 1972 through 5 March 1972.

Rear Admiral H. Suerstedt, Jr., USN, Commander, Naval Weapons Center, China Lake, California.

Mr. H. G. Wilson, Technical Director, Naval Weapons Center, China Lake.

Mr. F. A. Chenault, Director, Systems Development Department, Naval Weapons Center, China Lake.

Dr. W. F. Cartwright, Development Manager, AGILE Missile System.

Mr. G. S. Burdick, Head, Avionics Branch, AGILE Missile System Development Division.

Dr. F. R. Phillips, Head, Seeker Branch, AGILE Missile System Development Division.

Mr. J. W. Oestreich, Head, Weapons Systems Synthesis Branch, AGILE Missile System Development Division.

Mr. I. F. Witcosky, Head, Missile Engineering Branch, AGILE Missile System Development Division.

Mr. L. R. Gaynor, Head, Systems Management Branch, AGILE Missile System Development Division.

Mr. J. R. Bowen, formerly Head, Management Plans and Programs Branch, AGILE Missile System Development Division.

Mr. P. A. Douillard, Avionics Engineer, Avionics Branch, AGILE Missile System Development Division.

2. Interviews held in Washington, D. C., 10 through 18 January, 1973

Vice Admiral W. J. Moran, USN, Director of the Office of Research, Development, Test, and Evaluation, Department of the Navy (OP-098).

Captain T. J. Glancy, USN, Undersea and Strategic Warfare Development Division, Surface ASW and Mine Warfare (OP-981F).

Commander J. A. Muka, USN, Air Superiority Branch, Tactical Air, Surface and Electronic Warfare Development Division.

Mr. Robert A. Benneche, Assistant to the Director, Defense Research and Engineering for Ocean Control Systems.

Dr. Peter Waterman, Acting Assistant Secertary of the Navy for Research and Development.

Captain Crawford A Easterling. USN, Executive Assistant and Naval Aide to the Assistant Secretary of the Navy for Research and Development.

Rear Admiral K. R. Wheeler, SC, USN, Commander, Naval Systems Command.

Rear Admiral N. O. Wittman, USN, Director of Material Acquisition, Naval Air Systems Command (AIR-05).

Mr. J. A. Rexroth, Technical Assistant, Material Acquisition Directorate, Naval Air Systems Command (AIR-5018B).

Captain W. Mohlenholl, USN, AGILE Program Coordinator, Naval Air Systems Command (AIR-5108E).

Rear Admiral R. G. Freeman, USN, Deputy Chief of Naval Material for Procurement and Production (MAT-02).

Commander W. K. Washburne, SC, USN, Assistant for Policy and Planning, Office of the Deputy Chief of Naval Material for Procurement and Production (MAT-0211).

Dr. J. S. Lawson, Jr., Director of Naval Laboratories (MAT-03L).

Captain D. L. Keach, USN, Deputy Director of Naval Laboratories (MAT-03L1).

Captain R. J. Euatance, USN, Project Manager for the CVA (N) Acquisitions Project, Naval Ship Systems Command (PMS-392).

Rear Admiral R. L. Baughan, Jr., Project Manager for Major Surface Combatant Ships Project (PM-18).

Dr. G. K. Hartmann, Technical Director, Naval Ordnance Laboratory, White Oak, Md.

Mr. H. H. Varhus, Head, Specoa; Plans Division, Naval Ordnance Laboratory, White Oak, Md.

APPENDIX B

COMNAVAIR - COMNAVWPNSCEN AGREEMENT CONCERNING THE ADVANCED DEVELOPMENT AND PROTOTYPE TEST AND EVALUATION PROGRAMS FOR AGILE GUIDED MISSILE WEAPON SYSTEM

DATED
1 JULY 1971

COMNAVAIR - COMNAVWPNSCEN Agreement Concerning the Advanced Development and Prototype Test and Evaluation Programs for AGILE Guided Missile Weapon System

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Ref: (a) ASN (R&D) Conf memo to CNO and CNM of 26 April 1971

In keeping with the sprit and intent of reference (a), Commander, Naval Air Systems Command will assign responsibilities and delegate authority to Commander, Naval Weapons Center for the management and conduct of the Advanced Development and Prototype design test and evaluation phases of the AGILE Weapon System.

The purpose of this agreement is to establish the framework of understanding within which the project effort will be conducted.

SYSTEM DEFINITION

The AGILE Guided Missile Weapon System for which NAVWPNSCEN will be assigned development management responsibility includes but is not limited to the following:

1. Expendable Items

   a. Missile

      (1) Airframe
      (2) Guidance
      (3) Controls
      (4) Warhead
      (5) Fuze
      (6) Motor

2. Non-Expendable Items

   a. Visual target acquisition system
   b. Other Weapon Control System Elements not designed and provided as an integral part of the using aircraft.
   c. Launcher (if new development required)
   d. Peculiar Ground Support Equipment

      (1) For missile
      (2) For Non-expendable system elements

   e. Aircraft Modification Kit

PROJECT MANAGEMENT

NAVAIR will establish an AGILE Project Office as the primary point of contact in the Naval Material Command for the conduct of AGILE business. NAVWPNSCEN will designate a Development Manager resident at NAVWPNSCEN who will be responsive to the NAVAIR AGILE Project Coordinator or Manager as appropriate under the terms of this agreement (Figure 1 applies).

LONG RANGE PLANNING

Data required for broad AGILE planning, such as included in the Navy Strategic Study, tentative Program Objectives Memorandum, Weapon System Planning Documents, Material Planning Studies, etc., will be coordinated by NAVAIR. NAVAIR will provide such long range planning information as may be required by NAVWPNSCEN and solicit support as may be required for proper planning.

BUDGET PREPARATION AND PROJECT FUNDING

NAVWPNSCEN will have financial management responsibilities for those portions of the program for which responsibility has been assigned and will provide necessary data and cost estimates for its assigned responsibilities to NAVAIR for program, budget and review purposes. NAVAIR will have financial managment responsibility for the overall AGILE Weapon System Project.

NAVAIR will prepare, review, justify and defend programming, budget and apportionment estimates for the total AGILE Program. As appropriate and required, NAVWPNSCEN representatives will be called upon to supply data and provide back-up witnesses.

The entire amount of project funds requried and apportioned for support of the NAVWPNSCEN effort previously agreed to by both parties and expressed in the current version of the development plan will be made available to NAVWPNSCEN in a singel funding document issued by NAVAIR each year at the time of apportionment.

PROGRAM CONTROL DOCUMENTATION

NAVWPNSCEN will be responsible for the preparation and updating of the following essential documents:

(1) The Technical Development Plan (Adv. Dev.) - (Applicable to Concept Formulation (Validation) effort and Engineering and Development Planning).

(2) The Technical Development Plan (TDP) - (Applicable to Engineering Development.One of the Major outputs of the Advanced Development Program).

(3) The Advanced Procurement Plan (APP) - (Covers all contemplated contractual actions for the entire program span up to and including first competitive reprocurement or first volume procurement, whichever is sooner).

(4) The Performance Specification - (Performance specifications for the system, major subsystems and elements of the system to be developed and prototyped as GFE items are required as an output of the Validation effort and prior to release to prototype procurement).

(5) The Development Concept Paper - (Draft and review as requried).

The above items will be prepared by NAVWPNSCEN and submitted through NAVAIR and updated on a timely basis. Items 1, 2, 3, and 4 are subject to NAVAIR concurrence or approval as appropriate. All items will be used a s program control documents.

Requirements for the preparation of these documents will be delineated in the applicable AIRTASK assignments.

INDUSTRIAL PARTICIPATION

Developments of hardware or software for service use, beginning with the prototype program will be accomplished by NAVWPNSCEN or participating field activities working with and through industrial concerns capable of producing the quality and quantity of hardware needed for service use, at the desired rates. This industrial participation will be such that at the initiation of the prototype phase one of the participants can be designated as the weapon system or system integration contractor who, under the technical direction of NAVWPNSCEN, will:

(1) Evolve the production baseline configuration of the so-called contractor furnished portions of the weapon system.

(2) Participate in the performance of the system integration function by assisting in the development, establishment and management of total system configuration and the maintenance of CFE-to-GFE and weapon system-to-aircraft and carrier interfaces. The items of equipment and software to be developed as GFE will be determined by NAVWPNSCEN and treated appropriately in the APP. The number of such items will be held to a practical minimum.

CONTRACTING

Contracting for all procurements undertaken in support of the development program through the prototype phase will be accomplished by NAVWPNSCEN using procedures and contracting offices of their own choosing. Source selection will be accomplished by NAVWPNSCEN in accordance with CNM approved procedures. Final selection of contractors for prototype production must be concurred in by NAVAIR before announcement. A designated representative of the NAVAIR Project Coordinator/Manager will participate in all selections of prototype equipment contractors as a member of the source selection evaluation board or its equivalent.

DATA ACQUISITION

The end product of the NAVWPNSCEN-managed development program will be a proven prototype data package which wil provide for or support

a. A release to Pilot Production by the Prototype contractor
b. Inspection and acceptance of pilot production end items
c. Installation in test and evaluation aircraft
d. Operation by test and evaluation personnel
e. Maintenance and repair by Navy test and evaluation organizations

The NAVAIR Project Coordinator/Manager will validate this data package through in-process reviews.

CONFIGURATION CONTROL

Configuration Control for the advanced development period will be against the stated objectives of the ADO (Advanced Development Objective). For the early engineering development period beginning with prototype procurement and extending to the point of release to pilot production or delivery of first hardware for NTE, whichever is sooner, control will be agianst the performance specification or funcitonal baseline established in the advanced development (validation) program. The configuration control for pilot production will be against the product baseline disclosure provided in the release to pilot production. Deviations from the baseline configurations delineated above will require the prior approval of the NAVAIR Project Coordinator/Manager.

LIAISON

a. Intra-Project Liaison. All visits to participating field activities and contractors by personnel other than those reporting directly to the NAVWPNSCEN Development Manager will be coordinated with the NAVWPNSCEN Development Manager prior to their occurrence.

b. Inter-Service Technical Liaison. The NAVWPNSCEN Development Manager will conduct direct liaison with the Air Force on technical matters and will provide facilities for local Air Force liaison and/or technical representatives. All project action requriements levied upon the Air Force in the course of this development will be implememted with the concurrence of the NAVAIR Project Coordinator/Manager.

c. Liaison with Higher Authorities. NAVAIR will provide primary liaison with CMN, OPNAV, SECNAV, OSD and Congress relative to management of and progress reporting on the AGILE Project. The NAVWPNSCEN Development Manager will be called upon to supply information and provide back-up support. He will provide technical presentations, as appropriate.

d. Liaison with Aircraft and Related Equipment Contractors. The NAVAIR Project Coordinator/Manager will arrange for access of appropriate NAVWPNSCEN Project personnel to NAVAIR contractors for aircraft and related euqipment and will take all steps necessary to assure early detection of compatibility problems and their expeditious resolution.

COST ESTIMATING

The NAVWPNSCEN Development Manager will prepare and keep current, a detailed cost estimate for the complete development, test and evaluation program and will assist NAVAIR in the generation and update of production cost estimates. The cost model used for these estimates will be worked out in conjunction with and approved by the NAVAIR Project Coordinator/Manager.

INTEGRATED LOGISTIC SUPPORT

The NAVWPNSCEN Development Manager will coordinate all logistic support management planning and implementation with NAVAIR based on the procedures of NAVAIR Instruction 4000.2. He will provide a cochairman for the ILSMT (Integrated Logistics Support Management Team) constituted by NAVAIR.

CORRESPONDENCE

The NAVWPNSCEN Development Manager will provide the NAVAIR Project Coordinator/Manager with copies of pertinent correspondence between and among participating field activities, contractors and the Development Manager. The NAVAIR Project Coordinator/Manager will provide the Development Manager with correspondence and reports judged to be useful and/or desirable to the Development Manager.

REPORTING

a. Routine. A systematic, periodic reporting method will be established by the NAVWPNSCEN Development Manager to indicate progress of the AGILE development program in relation to the pre-established technical, fiscal and schedule milestones. Insofar as possible, such reports will be those used by the Development Manager.

b. Special. Special reports will be needed by the NAVAIR Project Coordinator/Manager from time to time to meet special requirements. Such reports will be provided by the NAVWPNSCEN Development Manager on a mutually agreed upon basis.

c. Technical. Periodic technical reviews will be scheduled by the NAVWPNSCEN Development Manager at least every fourth month at which time the technical status of the program will be discussed in detail. The NAVAIR Project Coordinator/Manager and selected members of his Headquarters staff will attend these meetings.

R. J. MORAN Rear Admiral, U.S. Navy Commander, Naval Weapons Center	T. R. McCLELLAN Rear Admiral, U.S. Navy Commander, Naval Air Systems Command

APPROVED:

J. D. ARNOLD Admiral, U.S. Navy Chief of Naval Material	R. A. FROSCH Assistant Secretary of the Navy (R&D)

APPENDIX C

NAVMATINST 5450.27
27 June 1972

NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555

Area Coordination: Commandant, Eleventh Naval District

A. Mission. The mission of the Naval Weapons Center, promulgated by reference (a), is to be the principal Navy RDT&E Center for air warfare and missile weapon systems.

B. Functions. The Naval Weapons Center shall establish and maintain the primary (although not necessarily exclusive) in-house research and development capability for the following Navy and Marine Corps systems, subsystems and technologies:

- Strike aircraft/weapon systems and concept development
  - Aircraft/weapon simulation
  - Survivability analysis and test
- Air-launched weapons and associated avionics systems
  - Aircraft guns and ammunition
  - Guided and unguided weapons
  - Aircraft weapons control and aircraft/weapons interface
  - Air weapon system simulation and effectiveness evaluation
- Tactical missiles
  - Anti-ship cruise missiles
  - Point defense missiles
- Subsystems for weapon systems defined above
  - Propulsion
  - Guidance and control
  - Warheads
  - Fuzes
  - Launchers, handling equipment
- Strike warfare countermeasures
- Weather modification

C. Facilities. The Naval Weapons Center shall maintain the following major facilities to support the functions assigned:

- Naval Air Facility
- Guided Missile Ranges
- Exterior Ballistics Range
- Terminal Ballistics Range
- Electronic Warfare Range
- Fuze Test Range
- Supersonic Test Tracks
- Aircraft Weapon System Test Ranges

Explosives Research and Development Facilities
Propulsion Research Laboratories
Aircraft Survivability Facility
Carrier Fire Simulation Facility
Microelectronics Facility
Microwave Anechoic Facilities

D. Program Offices. The Naval Weapons Center shall carry out assigned responsibilities for the following technical programs:

Guided missile propulsion
Attack and anti-air aircraft systems
Atmospheric applications research project
AGILE

E. Documentation. The Naval Weapons Center shall carry out assigned responsibility for timely submission and updating of the technical input to the following documents. In view of the diversity of technical competence in the Navy in-house RDT&E community, this responsibility includes solicitation of appropriate technical inputs from other activities.

Navy Technological Projections:
- Air/surface weapons
  - Propulsion
  - Guidance and control
- Environmental technology - air*

Navy General Operational Requirements:
- GOR 11 Airborne Attack
  14 Amphibious**
  16 Airborne Anti-Air Warfare+

Marine Corps General Operational Requirements:
- GOR Anti-Air Systems(AAS)

*To be transferred from NADC in FY 1973.
**Transfer to NCSL by FY 1974 is under consideration.
+Now assigned to NADC; transfer to NWC by FY 1974 is under consideration.

APPENDIX D

THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH AND DEVELOPMENT)
WASHINGTON, D.C. 20350

26 April 1971

~~CONFIDENTIAL~~ UNCLASSIFIED as of 1 Feb 1973
ASN R&D 218

MEMORANDUM FOR THE CHIEF OF NAVAL OPERATIONS
CHIEF OF NAVAL MATERIAL

Subj: AGILE Weapon System Development; responsibility assignment

The Advanced Short Range Air-to-Air Missile System, AGILE, Development Program was initiated in Fiscal 1968. The Development Concept Paper #15 and subsequent Deputy Secretary of Defense directions have resulted in the current Navy program for the development of a single missile system for joint USAF/USN service use.

In consonance with the importance of this program, I desire that the AGILE Weapon System design and development through prototype test and evaluation be the direct responsibility of the Naval Weapon Center, China Lake, California. The longer term problem of pilot line and production procurement should be accomplished jointly with the appropriate CNM organization. In order to provide early attention in the Engineering Design and Development Phase to production and support requirements, the appropriate CNM personnel should be assigned to the Naval Weapons Center project now. The NWC will seek technical assistance from other Naval laboratories, the Office of Naval Material and contractors when and as appropriate to the program needs.

The funds associated with the Design and Weapon System Development Phase will be under the fiscal management and control of the Naval Weapons Center.

I have asked the Director of Naval Laboratories to keep me informed as to the progress of this assignment and to give particular attention to the program to ensure that the system meets the joint requirements of the Navy and the Air Force as well as provides for the orderly transition of the system through development and production into inventory.

Copy to:
DEPSECDEF
ASAF(R&D)
DNL
COMNWC

ROBERT A. FROSCH

5419 ASN (R&D) Control No. C-647

APPENDIX E

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

IN REPLY REFER TO
Op-00:fs
Op-00 Memo 117-71
6 Feb 1971

MEMORANDUM FOR THE CHIEF OF NAVAL MATERIAL

Subj: Improved Research and Development Procedures

The present procedure for the procurement of new military equipment has been implemented in such a way that paper studies have largely replaced the testing of experimental hardware in guiding the preparation of requirements for production.

Based on my recent experience in Vietnam, I believe that judgement of the utility and acceptable cost of new equipment can only be established through experience with operating models. In addition, the trade-offs between different technical solutions can best be established by direct competition between their hardware implementations.

To do this effectively, I believe that we should allocate to the Navy laboratories the funding necessary to generate working models needed to establish the specifications and requirements for procurement.

In line with our current emphasis on decentralization of authority, please provide me your plan by which Program Managers would task and fund laboratories with the development of major system concepts and the construction and test of critical hardware.

For example would it not be possible to assign:

1. "CAPTOR" to the Naval Ordnance Laboratory.

2. Sonar and weapons for the mid 70 submarine to the Naval Underwater Systems Center.

3. The ULMS defensive suit to the Naval Undersea Research and Development Center.

E.R. ZUMWALT, JR.

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Naval Postgraduate School Monterey, California 93940	Unclassified
	2b. GROUP

3. REPORT TITLE

Project Management as Related to Weapon Development in Navy Research and Development Organizations

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Master's Thesis

5. AUTHOR(S) (First name, middle initial, last name)

William Scott Munro and Anthony Charles Brennan

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
June 1973	105	69

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Naval Postgraduate School Monterey, California 93940

13. ABSTRACT

The study investigates the role of Navy laboratories in the systems acquisition process. In particular, it looks at an attempt to expand the laboratories' traditional role of technical management of hardware projects in advanced and engineering development phases. The AGILE air-to-air missile development, the basis for this study, presents an opportunity to test the feasibility of decentralized management of defense procurement in actual practice.

In evaluating the effectiveness of Navy management of the acquisition process it is recognized that more than one criteria may be relevant. The evaluation is based on two standards of measurement: compliance with Department of Defense policy and conformance to generally accepted principles of management.

AGILE, a current development program, is traced from inception to the present and unique management problems are discussed. The authors conclude that unless a total commitment to decentralized management is made the present management structure should be retained.

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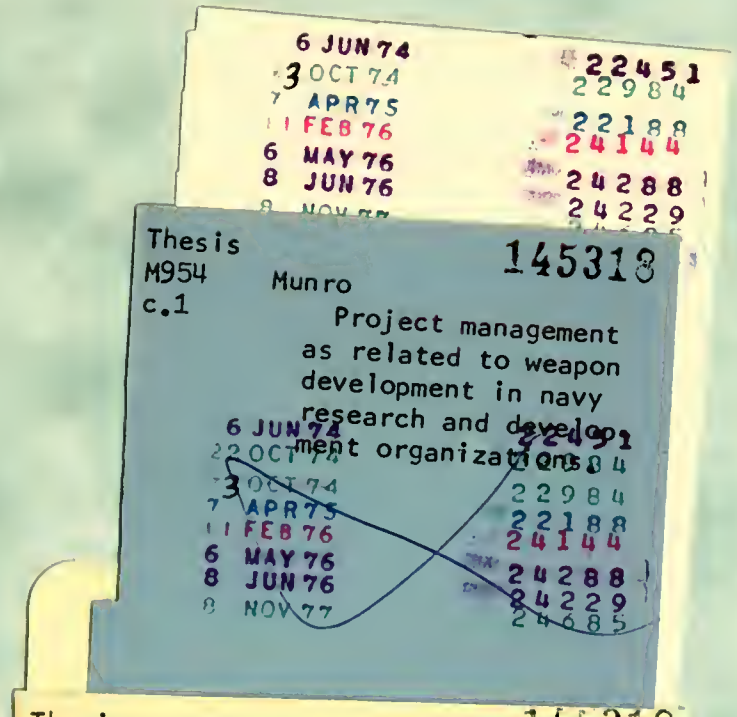
S/N 0101-807-6811

Security Classification

A-31408

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Systems Acquisition Management						
Project Management						
Navy Laboratories						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3 OCT 74
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11 FEB 76
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